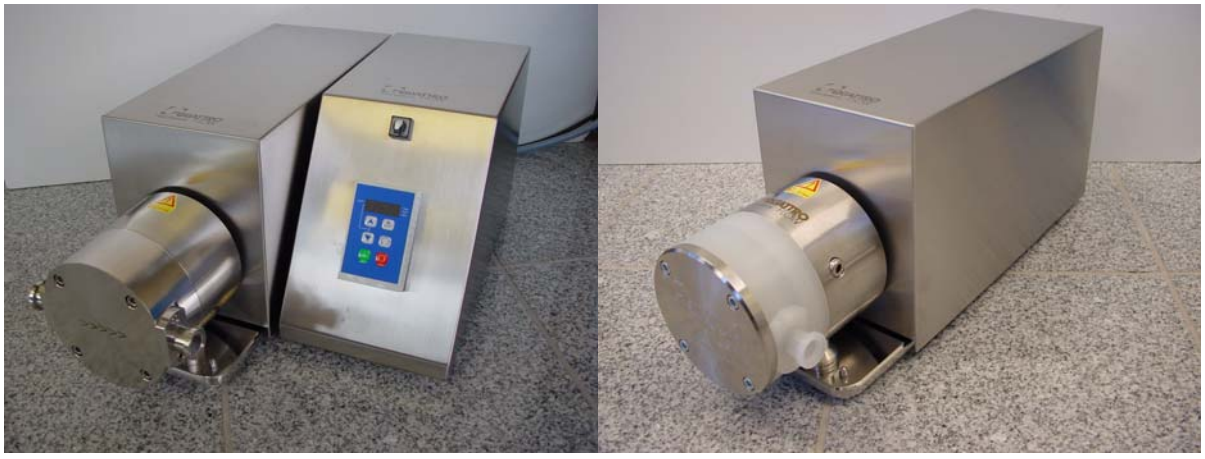
Version of 12.09.2011

User Manual

Quattroflow-1200 Series
4-Piston Diaphragm Pump



These two photographs show a Quattroflow-1200 S pump. The left one with a stainless steel pump chamber. The right one with a “Single-Use” pump chamber made of Polypropylene. The control box can positioned beside, on top or separated from the pump housing. Other versions are available.

Safety
These operating instructions contain hints to be observed during installation, operation and maintenance. Therefore, prior to mounting and commissioning, these operating instructions must be read by the user and must always be available at the place of installation.

Performance Data
The exact performance data applying to the pump are to be taken from the order data sheet.

These Operating and Maintenance instructions contain information from the pump manufacturer. They may need to be supplemented by instructions of the operator company for its personnel.

ALMATEC Maschinenbau GmbH is constantly working on improvements of the pump. Modifications of the design or materials might be done without prior notice.

1. General
- 1.1 Appropriate Specification
- 1.2 Labelling of the Pump

2. Safety
- 2.1 Marking of hints in the operating instructions
- 2.2 Personnel qualification and personnel training
- 2.3 Responsible working
- 2.4 Dangers in case of non-compliance with the safety hints
- 2.5 Safety hints fort the user and/or operator
- 2.6 Safety hints for maintenance, inspection and mounting operations
- 2.7 Arbitrary reconstruction and spare part production
- 2.9 ***Attention! Warning hints!***
- 2.10 ***Attention! Safety hints!***

3. Description of the Quattroflow-1200 S Pump
- 3.1 Application and range of utilization of the Quattroflow-1200 S pump
- 3.2 Typical application of the Quattroflow-1200 S pump
- 3.3 Description of the function of the Quattroflow-1200 S pump
- 3.4 Start-up

4. Maintenance and servicing of the Quattroflow-1200 S pump
- 4.1 Changing of the diaphragms and valves
- 4.2 Changing of the ball bearing unit (shaft-ball bearing-connector plate)
- 4.3 Mounting of the pump chamber
- 4.4 Dismounting of the pump chamber
- 4.5 Dismounting of the drive unit
- 4.6 Mounting of the drive unit
- 4.7 Dismounting of the drive housing
- 4.8 Mounting of the drive housing

5. Operating troubles, causes and remedial actions
- 5.1 Pump does not start
- 5.2 Pump does not prime
- 5.3 Delivery is not obtained
- 5.4 Pressure head is not obtained
- 5.5 Irregular pump delivery
- 5.6 Pump operates noisily
- 5.7 Pump is leaky
- 5.8 Motor gets to warm
- 5.9 Display show error code

6. Performance chart of the Quattroflow-1200 S pump
- 6.1 Diagram 1 Discharge as function of pump rpm
- 6.2 Diagram 2 Discharge as function of frequency

7. Technical data of the Quattroflow-1200 S pump

1. General:

1.1 Appropriate specification

This User Manual is valid fort the **Quattroflow-1200 S pump**

No liability will be undertaken for any damages caused by non-compliance with the operating instructions and service conditions! Original spare parts serve safety purposes. The use of other parts may cancel the liability for the consequences resulting therefrom.

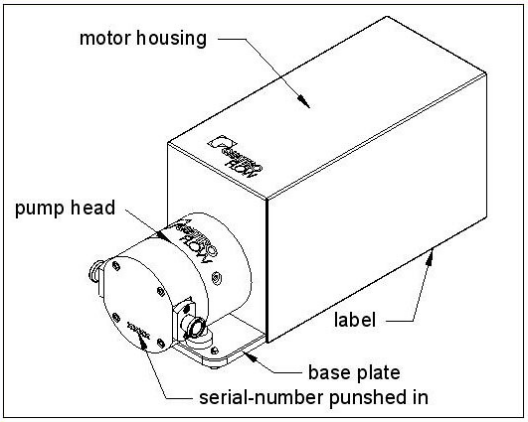
Manufacturer: ALMATEC Maschinenbau GmbH

Carl-Friedrich-Gauss-Str. 5
D-47475 Kamp-Lintfort
Germany

Phone: +49 2842 961-0
Fax: +49 2842 961-40
e-mail: quattroflow@almatec.de
Internet: www.quattroflow.com

1.2 Labelling of the pump

The type label of each Quattroflow pump can be seen on the bottom of the base plate.
Besides the serial No of the pump head is punshed in, at the front cover.



2. Safety

These operating instructions contain basic hints to be observed during installation, operation and maintenance. Therefore, prior to mounting and commissioning, these operating instructions must by all means be read by the fitter as well as the pertinent expert personnel/customer and must always be available at the place of installation of the pump. Not only are the general safety hints listed under this item “Safety” to be observed, but also the special safety hints such as for specific use at the user’s site.

2.1 Marking of hints in the operating instructions

The safety hints contained in these operating instructions which, in case of non-compliance, may cause danger to personnel, are particularly marked with the danger symbol.

Safety sign according DIN 4844 - W 9

In case of warning against electric voltage with:

Safety sign according DIN 4844 – W8

Safety hints which, in case of non-compliance, may cause danger to the pump itself or to parts of the systems are particularly marked with

the word: ***ATTENTION!***

Marking labels at the pump e.g.

- Pmax 8bar
- Direction of flow

must not be removed and care have to be taken that these labels are readable.

2.2 Safety hints for maintenance, inspection, mounting and operation

The customer shall see to it that all maintenance, inspection and mounting operations are performed by authorized and qualified expert personnel who have sufficiently informed themselves by thoroughly studying the operating instructions. Basically, operations at the machine must be performed during standstill only. Pumps handling noxious fluids must be decontaminated.

2.3 Responsible working

Please follow strictly the safety guidelines that are issued for your particular enviroment. Eg. the handling of chemicals, like caustic or acid, the handling of biological materials, the handling of tubing, piping, instrumentation, fittings etc.

2.4 Dangers in case of non-compliance with safety hints

In case of non-compliance with the safety hints may cause danger to personnel, equipment and environment.

It can cause:

- Failure of the proper function of the pump/system.

- Danger to personnel by electrical, mechanical, chemical, biological impacts.

- Danger to equipment and environment

2.5 Safety hints for the user / operator

- In case of hot parts (e.g. while CIP or SIP) protective measures have to be taken.

- Protecting covers of moving parts (e.g. coupling, cover of motor) must not be removed.

- Leakages of dangerous materials to be handled must be discharged so as not to result in danger to persons or he enviroment. Legal stipulations are to be obeserved.

- Dangers by electrical energy are to be excluded (for details with regard to hereto, please refer to the regulations of the VDE and the local energy supply associations.

2.6 Safety hints for maintenance, inspection and mounting operations

The customer shall see to it that all maintenance, inspection and mounting operations are performed by authorized and qualified expert personnel who have informed themselves by thoroughly studying the operating instructions.

Basically operations at the machine must be performed during standstill only.
Disconnect mains supply before opening the electrical cabinets (control box).

Pumps or aggregates handling noxious fluids (e.g. caustic, bio hazardous) must be decontaminated.
Prior to restarting all items and the pump are to be observed.

2.7 Arbitrary reconstruction and spare part construction

Reconstruction of or changes to the machine are only admissible after consultation with the manufacturer. Original spare parts and accessories authorized by the manufacturer serve safety purposes. The use of other parts may cancel the liability for the consequences resulting herefrom.

2.8 Inadmissible modes of operation

The operating safety of the machine supplied is only ensured with due application according to the operating instructions. The limit values given in the data sheet must by no means exceeded.

2.9 Attention*! Warning hints!*

These warning hints are to prevent the user from an inadmissible mode of operation. These warning hints are to be strictly followed to avoid any damage of the pump and/or any danger to personnel.

Diapragm pumps are positive displacement pumps and can theoretically generate an infinitely high pressure. With the discharge line closed, e.g. by clogging or by incidental closing of a valve, the pressure generated by the pump may reach a multiple of the admissible pressure of the plant. This may lead to bursting of the diaphragm or lines which must be absolutely avoided especially when handling dangerous products.

- ⚠ Diameter of the suction line need to be sufficient to avoid cavitation.
- ⚠ The use of a safety device (e.g. pressure switch) can be necessary.
- ⚠ Please make sure that prior to the start of the pump the discharge line is checked. Make sure that there is no flow restriction in the discharge line to avoid any over pressure (e.g. closed valve).
- ⚠ Check all seals (e.g. TC clamps) before the pump is started.

The maximum discharge pressure depends on the temperature of the fluid.
pmax at room temperature = 8 barg
pmax at 90° C = 3 barg

Please allow the pump to cool down after heat treatment (e.g. CIP / SIP).

Flush the pump prior to use with appropriate fluid (e.g. buffer)

- ⚠ Foundation design: The foundation must be designed so that it can take the weight of the pump aggregate on the entire surface.
- ⚠ Please make sure that the pump is operated with the proper mains voltage and frequeny to avoid damages and electrical danger.
- ⚠ Make sure that the slots for the cooling air are not blocked.

Due to the versatile possibilities to use the Quattroflow-1200 s pump it is highly recommended to check case by case if the Quattroflow-1200 S pump will be the right tool for the specific application. The user/operator is responsible to perform a proper method of testing if the pump should be applied for his specific application.

The chemical and thermal compatibility of the elastomeric parts of the pump with the fluid that will be pumped are to be checked by the operator before the first process run.

E.g. Oily, fatty fluids or solvents might cause a swelling and/or destruction of the elastomeric components.
If in doubt, please contact the manufacturer!

- ⚠ Operating the pump in humid or aggressive air can cause damages to the motor and control box.
- ⚠ The control box should not be exposed to spray/splash water or to heat sources.

If the Quattroflow-1200 S pump is to be used under rough conditions (e.g. high-pressure cleaners, exposed to sea water), the manufacturer can supply special equipment, like motors and controls.

2.10 *Attention! Safety Hints!*

The following safety hints notify you of the potential of bodily harm or life danger of the user/operators!

- ⚠ Please read and follow the safety hints and warnings to avoid any risk of bodily harm, life danger and/or the damage of equipment.
- ⚠ Please keep this User Manual available. Make sure that the operators of the pump have read and understood the User Manual. A training session might be appropriate.
- ⚠ We recommend to install specific warning labels at the system.

Disconnect mains before doing any maintenance!
The housing of the control box is to be opened only by skilled personnel.
Check the electrical cables before connecting to mains supply.

- ⚠ The Quattroflow-1200 S is a positive displacement pump and can theoretically generate an infintely high pressure even at low speed (rpm). Prior to each start of the pump check and make sure that the discharge line is not closed or restricted. The design of the discharge line must not build up a pressure of > 8 barg.
- ⚠ If suction and/or discharge line are flexible tubing, then make sure that these tubings do have the proper pressure rating for the full range of temperatures that are applied.

pmax. = 8 bar, Do not exceed! Warning Label: p max: 8 bar! Do not remove!
If the maximum pressure is exceeded it can happen that the diaphragm of the pump will burst. In this case the fluid will come out of the pump and can cause a danger for the personnel and/or enviroment (e.g. caustic cleaner).

The Quattroflow-1200 S pump can pump air which means that most of the fluid inside the pump chamber will be pump out. However there will be a residual amount of fluid (appr. 1 – 5 ml) inside the pump chamber that should be flushed out of the pump before the pump will be opened.

- ⚠ Please follow the general safety guidelines when handling chemical fluids (wear gloves and/or glasses) before the pump chamber will be opened.

- ⚠ Never operate the pump without coupling and motor housing.

- ⚠ The foundation must be designed so that it can take the weight of the pump on the entire surface.

The Quattroflow-1200 S must not be operated in ATEX zones.
Special versions for ATEX applicationen are available.
Please contact the manufacturer in case that the Quattroflow-1200 S pump needs to be modified for ATEX applications.

ALMATEC Maschinenbau GmbH

Attention! Inadmissible modes of operation, arbitrary reconstruction, spare parts production and/or any changes of the design (without admission of the manufacuturer) may cancel the liability for the concequences resulting therefrom.

3. Description of the Quattroflow-1200 S pump

3.1 Application and range of utilization of the Quattroflow-1200 S pump

The Quattroflow-1200 S is a 4-piston Diaphragm pump, which is mainly used to pump water-like fluids that are typically handled in research-, pilot plant- or production facilities of the pharmaceutical, biotech, food or cosmetic research centers or plants.

Typical examples of these fluids:

- Solutions containing proteins (albumin, IgG, Clotting factors, monoclonale antibodies, enzymes, vaccines.)
- Solutions of polymers or suspensions (silicons, latex, chromatography media)
- Cell suspensions (bacteria, yeast, algae, fungi, mammalian cells)
- colloidale solutions
- Suspensions of virusses or phages
- Dairy products
- Gelatine
- Supplements and ingredients for cosmetic and food.

3.2 Typical process steps in which the Quattroflow-1200 S pump is used

Filtration technology

- **To recirculate feed/retentate (e.g. membrane cassettes, hollow fibre, spiral wound, ceramic elements.**
- **Feed pump for filter cartridges or plate and frame depth filters**

Chromatography:

- **Packing of chromatography columns**
- **Feed pump to mix gradients**
- **Feed pump for centrifuges or separators**
- **Feed pump for homogenizers**
- **Feed pump for filling machines**

3.3 Discription of the working princaple Quattroflow-1200 S

The Quattroflow-1200 S pump is a 4-piston diaphragm pump. The 4 segments of the pump diaphragm oscillate back and forth. This alternate movement is created by a connector plate that is arranged on a ball bearing. The ball bearing sits on an eccentric shaft. The connector plate does not turn!
The stroke of the pistons is determined by the angle of the eccenter. There are eccentric shafts with 5° and 3° available. The range of flowrates can be modified by changing the eccentric shafts.
Range of flow rate:
5° eccentric shaft: appr. 20 -1200 L/hr
3° eccentric shaft: appr. 10 - 800 L/hr
The drive = motor + control needs to be choosen according to application.

Please note:

The direction of flow can be adjusted by turning the pump chamber in 90° steps.

The Quattroflow-1200 S is **self-priming and can run dry**. Inside the pump chamber there are no rotating parts that might cause heating up of the product or shed particles.

The pump-motor unit is mounted on a stainless steel base plate. In case that the pump will not be mounted on the base plate but in a frame or any other base measures have to be taken that there will be a proper alignment of the motor and the pump.

3.4 Start-Up

Prior to leaving our factory all pumps are subjected to a leakage and performance test. Only properly operating pumps leave the factory achieving the performances assured by us. It is possible that there will be a few mls of water inside the pump.

Prior to each use we recommend to flush the pump with a proper fluid (e.g. water or buffer).

Prior to the very first use it might make sense to clean and sanitize the pump chamber.
A commmercial caustic cleaner and/or 1n bis 0.5n NaOH can be applied.
The choosen cleaning agent can be recirculated and also stored inside the pump chamber.

For flushing out of any cleaning agent do not recirculate! Check with appropriate analytical methods the success of the flushing procedure.

Recommendation: Test run prior first use!

Before using your pump in your process (e.g. as recirculation pump in a TFF system) perform a test run to get used to the specific properties of the pump.

Please note:

ALMATEC Maschinenbau GmbH is also building custom-made pumps and set-ups. These modified pumps can be different from this one that is described in here. However the basic information is applicable to all of the Quattroflow-1200 (S) Series pumps.

Please do not hesitate to contact us for further information:

ALMATEC Maschinenbau GmbH

Carl-Friedrich-Gauss-Str. 5
D-47475 Kamp-Lintfort
Germany

Tel: (0 28 42) 9 61-0
Fax: (0 28 42) 9 61-40
e-mail: quattroflow@almatec.de
Internet: www.quattroflow.com

4. Maintenance/Servicing of the Quattroflow-1200 S pump

Due to the robust construction the Quattroflow-1200 S pump requires only little and easy- to-do maintenance.
The ball bearings do not need any extra lubrication.

The diaphragm and the valves are wear parts. These should be checked and if needed be changed once the performance of the pump decreases.
In case that the diaphragm broke it needs to be replaced. Then it is also recommended to check the ball bearings if these are still working smoothly or if these are hard to turn and are noisy during operation.

Attention! Safety hints!

After purging the pump with air there might be a small residual amout of fluid inside the pump chamber.
Flush the pump chamber thoroughly and check the rinse fluid.

Please follow the general guidelines and safety advices when handling with chemicals.

Disconnect mains supply before opening the pump housing!

The dismounting and mounting of the pump should be done on a rigid table or work bench. Please note: the pump is heavy.

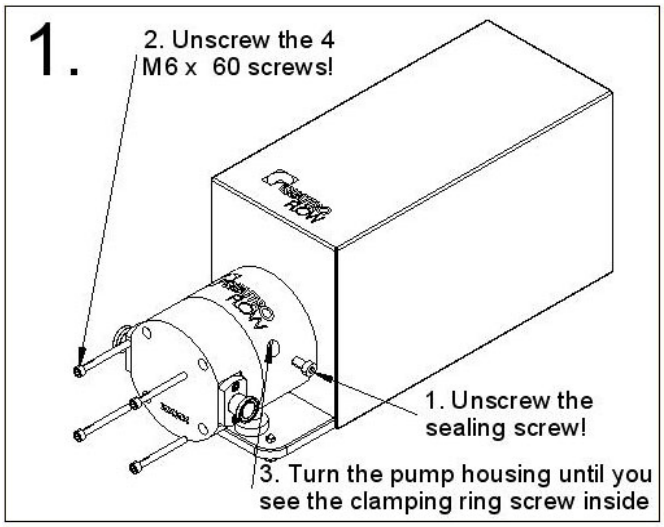
4.1 Changing of the diaphragm and valves

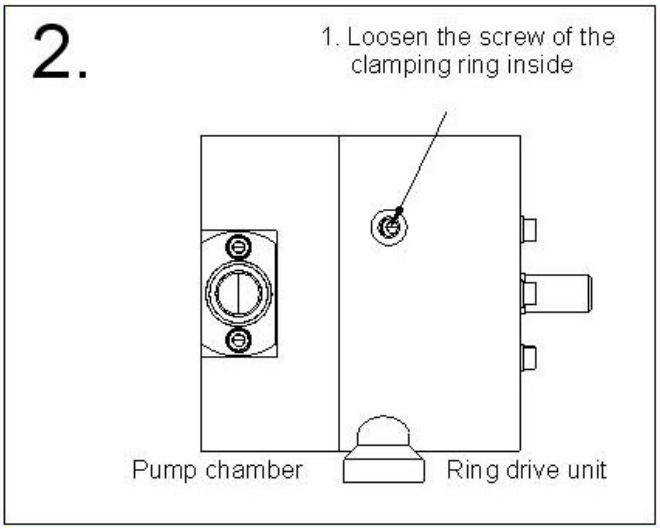
The changing of the diaphragm and the valves can be done by the user.
Please follow the schematic drawings “Dismounting of the pump chamber” and “Mounting of the pump chamber”
Spare part kit: PSKITQ12

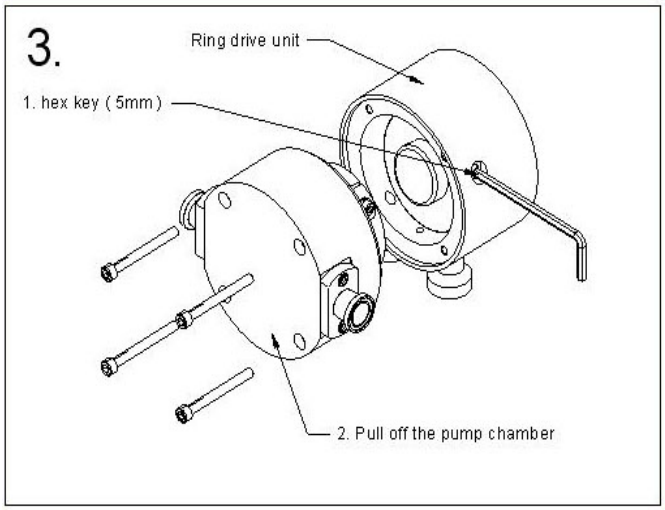
4.2 Changing of the shaft–bearing–cap unit

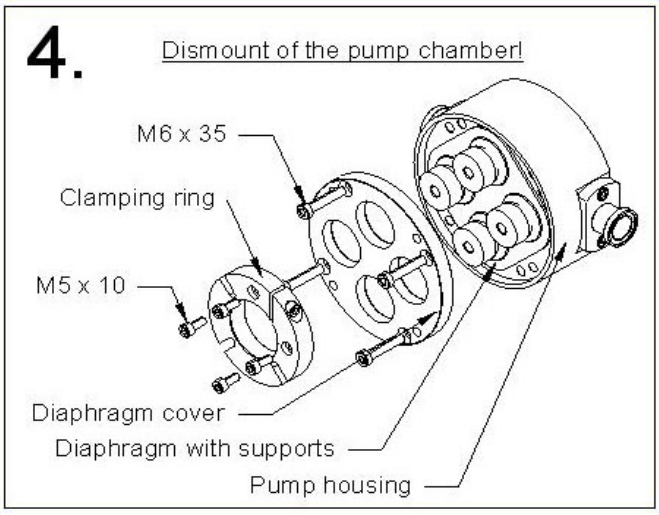
The changing of the shaft-bearing-cap unit can be done by the user. Please follow the schematic drawings “Dismounting of the ring drive unit” and “Mounting of the ring drive unit”
Spare part kit: PSKITWLC123 (3° excentric shaft) or PSKITWLC125 (5° excentric shaft)

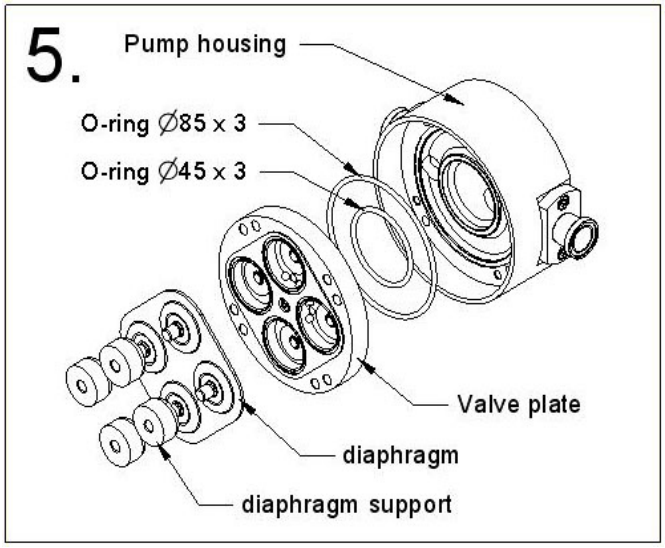
4.3 Dismounting of the pump chamber:

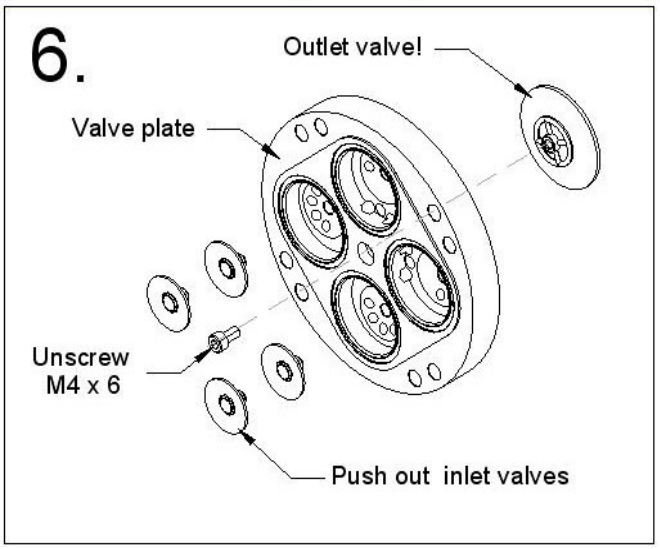

1.
2. Unscrew the 4 M6 x 60 screws!
1. Unscrew the sealing screw!
3. Turn the pump housing until you see the clamping ring screw inside



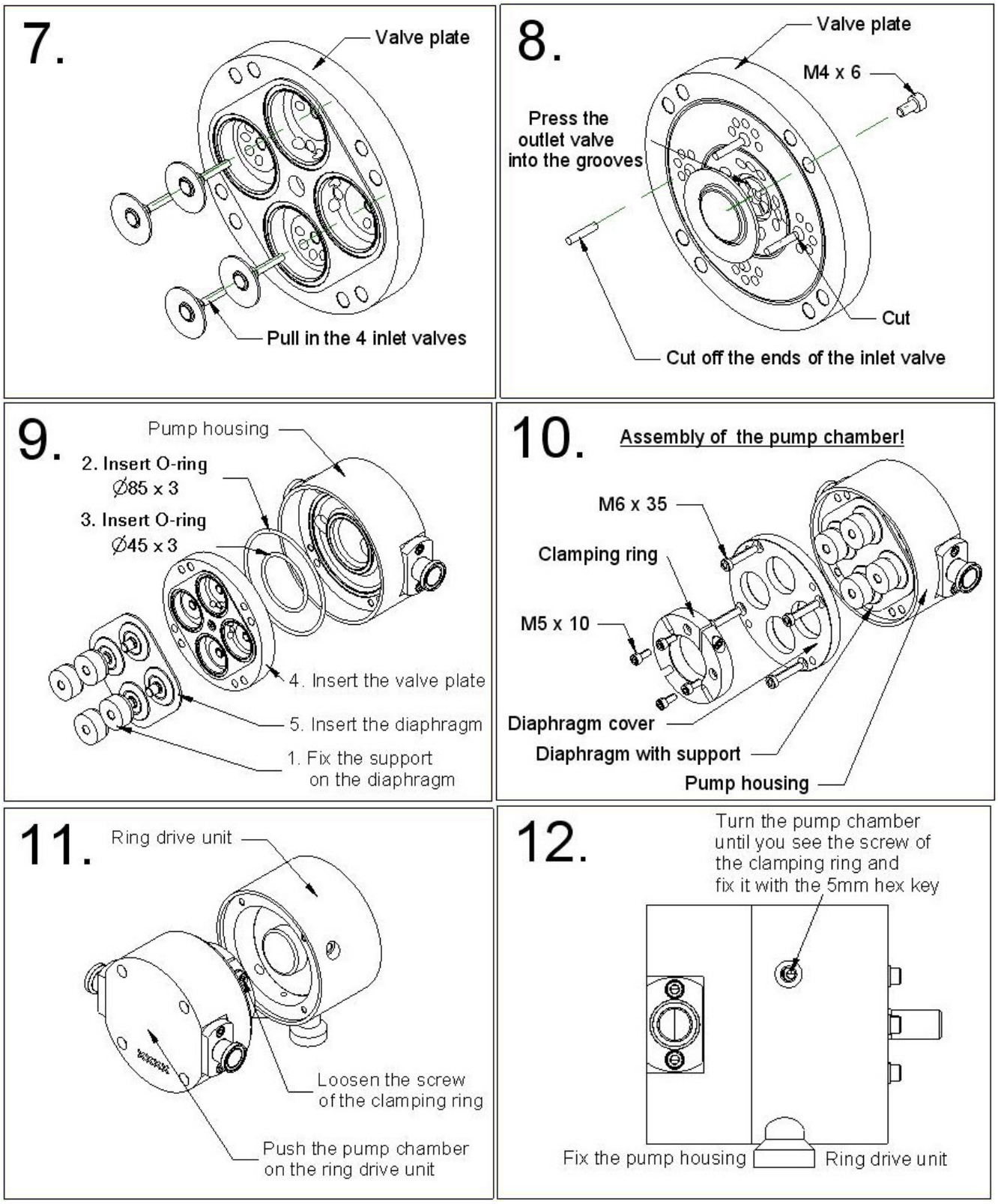




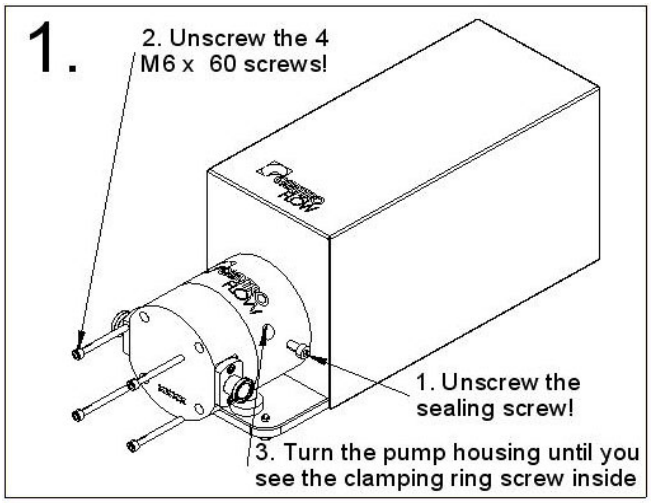


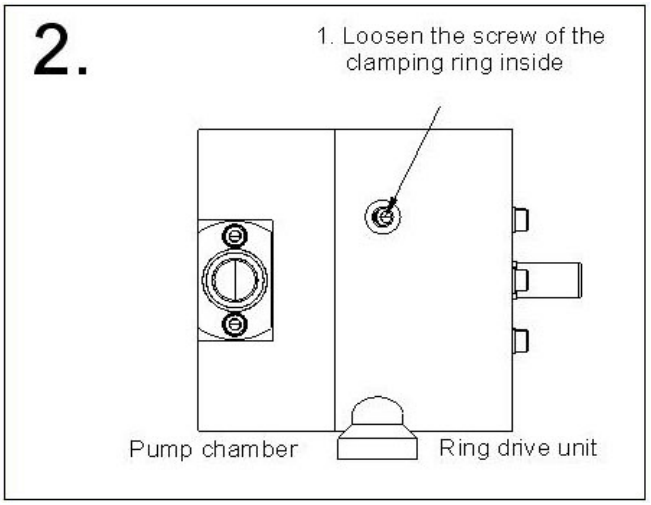


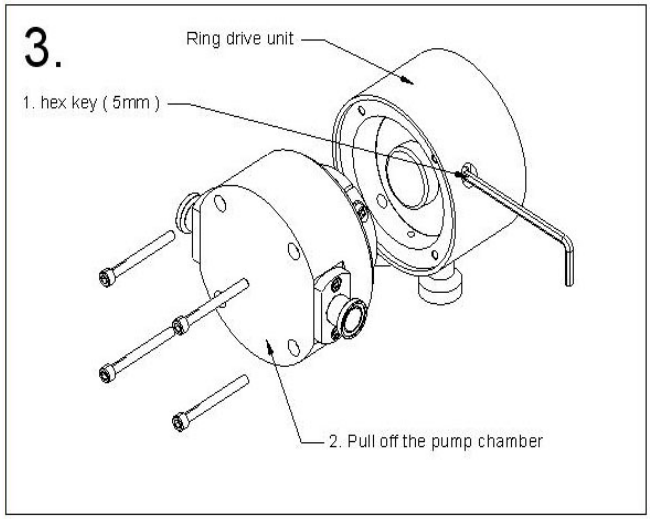
4.4 Mounting of the pump chamber:

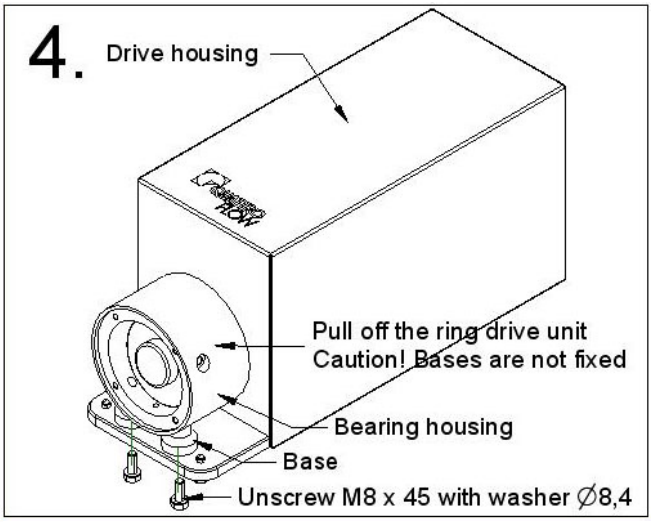

7.
Valve plate
Pull in the 4 inlet valves
8.
Valve plate
M4 x 6
Press the outlet valve into the grooves
Cut
Cut off the ends of the inlet valve
9.
Pump housing
2. Insert O-ring Ø85 x 3
3. Insert O-ring Ø45 x 3
4. Insert the valve plate
5. Insert the diaphragm
1. Fix the support on the diaphragm
10.
Assembly of the pump chamber!
M6 x 35
Clamping ring
M5 x 10
Diaphragm cover
Diaphragm with support
Pump housing
11.
Ring drive unit
Loosen the screw of the clamping ring
Push the pump chamber on the ring drive unit
12.
Turn the pump chamber until you see the screw of the clamping ring and fix it with the 5mm hex key
Fix the pump housing
Ring drive unit

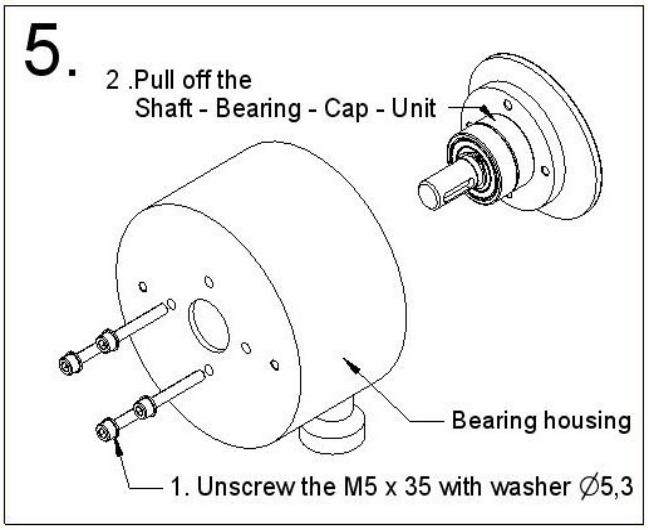
4.5 Dismounting of the ring drive unit:


1.
2. Unscrew the 4 M6 x 60 screws!
1. Unscrew the sealing screw!
3. Turn the pump housing until you see the clamping ring screw inside

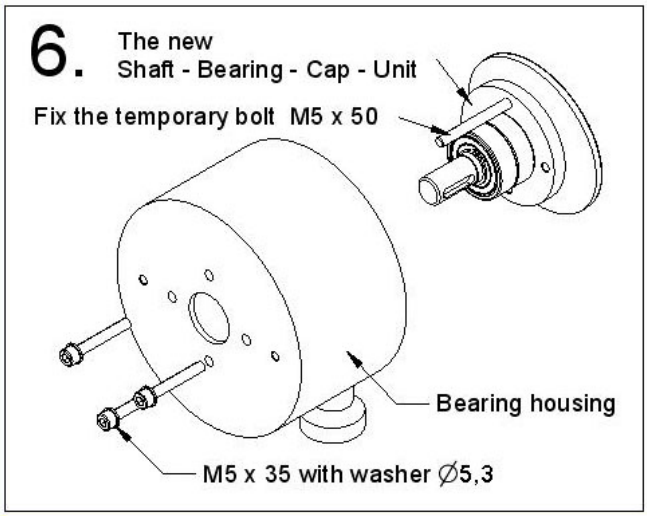


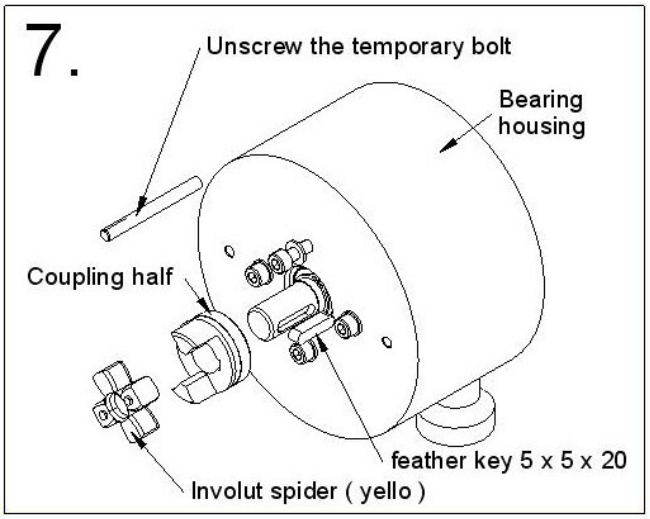


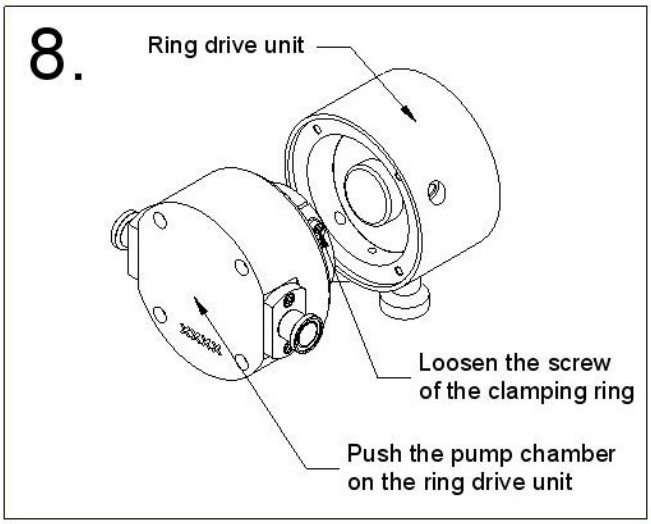


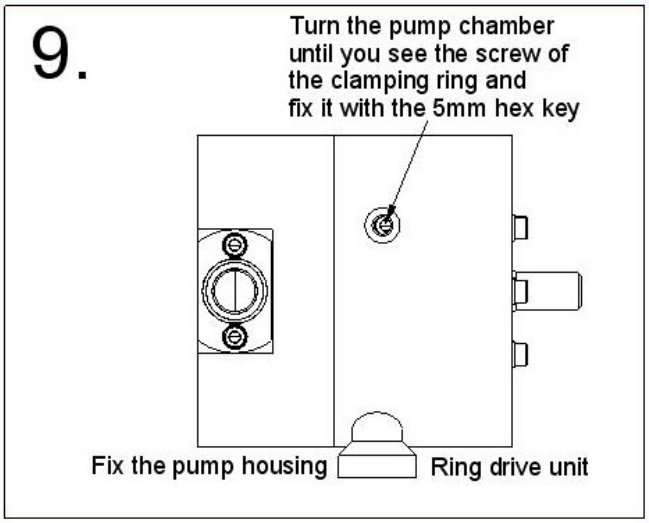


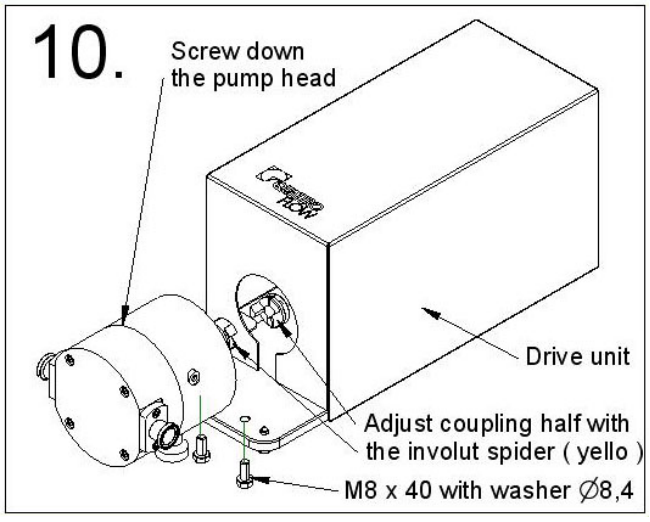
4.6 Mounting of the ring drive unit:





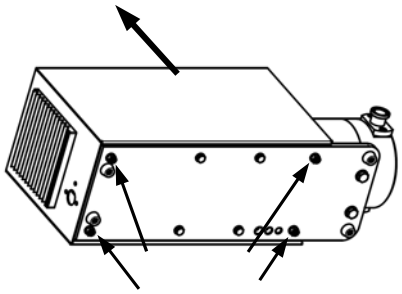



9.
Turn the pump chamber until you see the screw of the clamping ring and fix it with the 5mm hex key
Fix the pump housing
Ring drive unit



4.7 Dismounting of the drive housing:

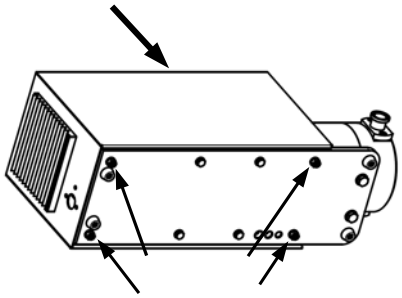
1. Dismounting drive house:



4x M6 (wrench size10)
remove screws.

4.8 Mounting of the drive housing:

1. Mounting of drive house:



Fitting 4x M6 (wrench size10)
screws with washer.

5. Operating troubles, causes and remedial action:

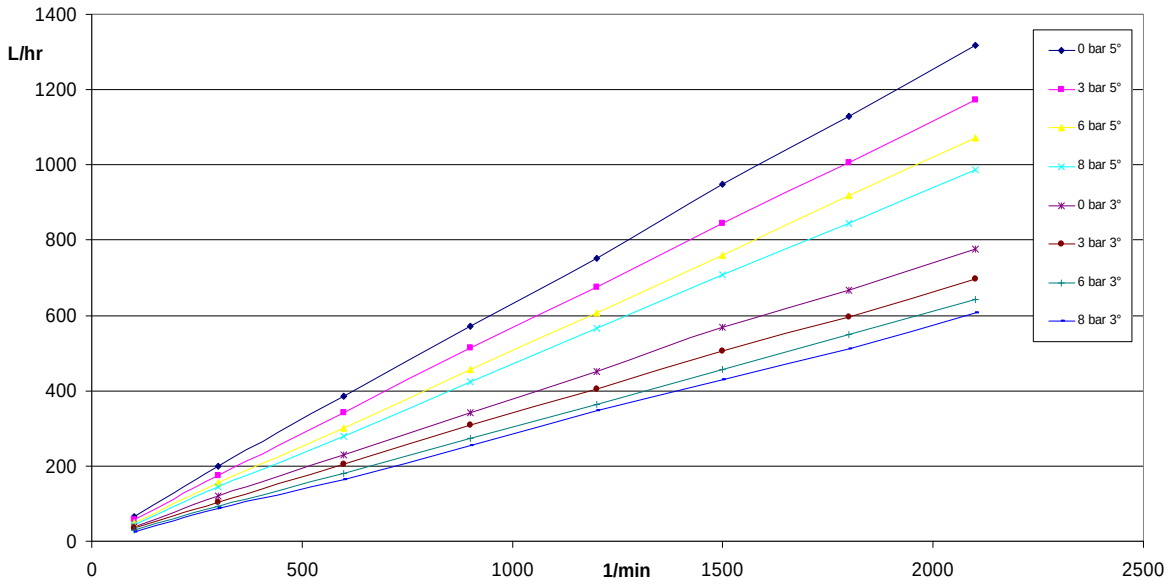
No.	Operating troubles									Causes and remedial action
	Pump does not start	Pump does not prime	Delivery is not ob-tained or reduced	Pressure head is not obtained	Irreg-ular pump delivery	Pump oper-ates noisily	Pump is leaky	Motor gets too warm	Display show Error code	The 4-piston diaphragm pump operates trouble-free at any time provided they are applied according to the operating conditions mentioned in this manual. If indought please contact Quattroflow Fluid Systems
	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	
1		X					X			The screws of the pump-chamber maybe not thightened enough. Fixe it!
2		X								Check the direction of flow showed by the arrow on the pump, in case of wrong way, turn the pump head
3		X	X			X				Check suction pipeline and TC- seals for tightness
4		X	X	X	X					Check suction head-increase suction line cross section.
5		X	X	X						Check viscosity of liquid pumped.
6	X								X	Check pump speed. Control speed of drive motor. Check voltage and frequency and the fuse (6,3A T in the controlbox)
7			X	X	X					Avoid air inclusions in the liquid to be pumped
8			X		X					Check pressure head-open valve in discharge line completely, remove obstruction in discharge line
9							X			Pressure line completely or partly clogged Diaphragm maybe broken Change diaphragm!
10			X							The diameter of the pipes in suction or pressure line are to small
11						X				Check the coupling halves. They must be fixed with at least 2-3mm space.
12						X				Check longitudinal play of coupling rod pins. The spider might be worn.
13		X	X		X					Check whether foreign bodies in pump. Disassemble pump, remove foreign bodies, replace defective parts
14	X							X	X	Pump stopped by the Thermistor switch. Please alow the motor to cool down – please reduce the power consumption.
15	X					X				Bearings are worn or defektive Disassemble pump, replace the shaft – bearing – cap unit (PSKITWLC123 or /PSKITWLC125)
16		X								The valves are dry (e.g. not in use for a long time), deformed or worn. Change valve or wet the pump.
17							X			The diaphragm is burst (the discharge pressure was too high) – replace it PSKITQ12
18		X	X	X			X			O – rings between valve plate and pump housing are defective PSKITQ12
19						X				Align coupling accurately
20			X			X				The clamping ring screw got loose – fixe it! See 4.4 Mounting of the pump chamber (picture 12)

6. Performance chart of the Quattroflow-1200 S pump:

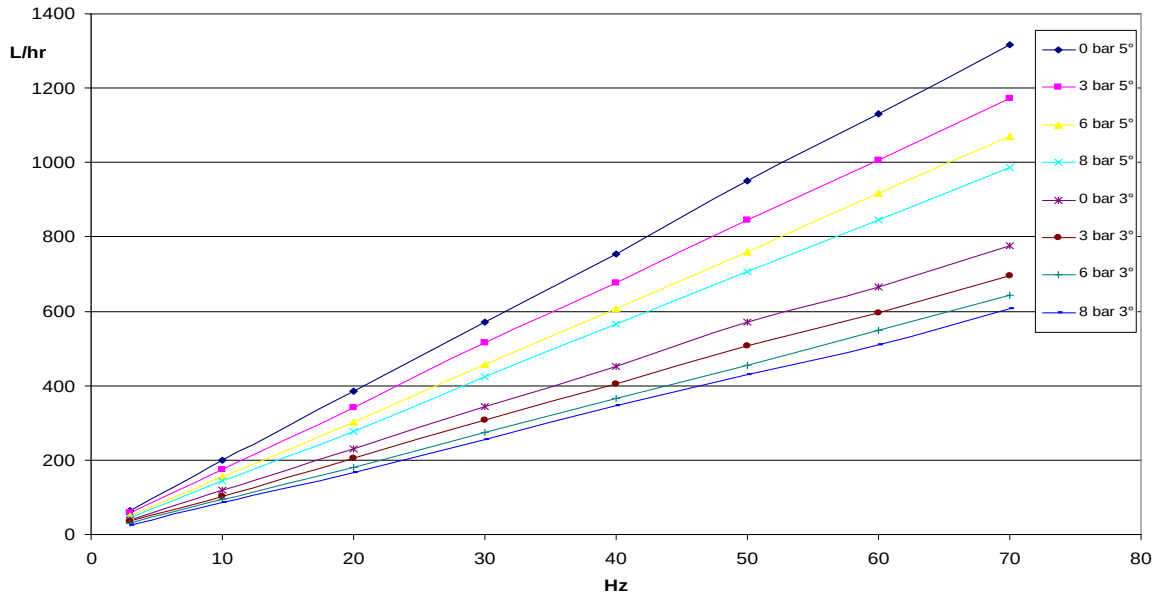
Performance Diagram Quattroflow-1200 S Pump
Testmedia: Water at ambient temperature
Eccentric shaft: 3° resp. 5°
Discharge pressure: 0 to 8 barg

6.1 Diagram 1: Shows appr. Flow rates as function of pump rpm.

Please note: If motor is directly coupled to pump: Pump rpm = motor rpm
If reducer gear drives are used: Pump rpm = motor rpm x reduction ratio



6.2 Diagram 2: Shows appr. flow rates as function of the frequency when a frequency inverter is used to control a 4-pole AC drive, which is directly coupled to the pump.



7. Technical data of the Quattroflow-1200 S pump:

	4-piston-diaphragm pump:	
	Eccentric shaft:	5° or 3°
	Flow rate max 5°:	appr. 1200 L/h at 0 bar (appr. 70 Hz)
		appr. 800 L/h at 8 bar (appr. 70 Hz)
	Flow rate min 5°:	appr. 30 L/h at 0 bar (appr. 3 Hz)
		appr. 20 L/h at 8 bar (appr. 3 Hz)
	Pressure (temperature of fluid < 40 °C) max:	8 bar
	Pressure (temperature of fluid > 40 °C) max:	4 bar
	Volume of pump chamber without connectors:	appr. 75ml
	Surfaces area with contact of fluid:	appr. 175cm²
	Residual volume, depense on position of ports:	1- 5ml
	Temperature of fluid:	CIP 90°C, SIP 125 °C, Autoklav 125°C
	Speed range:	60 - 2400 rpm
	Diaphragm:	EPDM/PP compound (Santoprene)
	Valves:	EPDM
	O-rings:	EPDM
	Available certificates for elastomer parts:	FDA 177.2600, USP Class VI, ADIfree
	Valve plate:	Stain steel 1.4435 optional 1.4539, e-polished, Ra < 0,4µm, Ferrite < 1%
	Pump housing:	Stain steel 1.4435 optional 1.4539, e-polished, Ra < 0,4µm, Ferrite < 1%
	Connector inlet (standard) other dimetions are available:	TC-clamp 3/4", Stain steel 1.4435 optional 1.4539, e-polished Ra<0,4µm
	Flange diameter inlet:	25 mm
	Internal diameter inlet:	15,75 mm
	Connector outlet (standard): other dimetions are available:	TC-clamp 3/4", Stain steel 1.4435 optional 1.4539, e-polished Ra<0,4µm
	Flange diameter outlet:	25 mm
	Internal diameter outlet:	15,75 mm
	Available certificates for stainless steel parts:	DIN EN 10204 3.1 B, Ra / Ferrite
	Position of connectors:	In line (other positions are available)
	Flow directions:	4 (in 90° steps)
	Motor (standard):	370 W, 4-pole, thermistor, IP 55
	Additional cooling fan:	12,5 W
	Coupling:	KTR
	Base plate:	Stainless steel 1.4301, e-polished
	Motor housing:	Stainless steel 1.4301, e-polished
	Dimensions (L / W / H):	520 x 155 x 210 mm
	Weight of the pump:	appr. 24 kg
	Controlbox:	PCACTLZ37, IP 54
	Frequency inverter:	Lenze, Typ SMVector, 0,37kW
	Panel:	Lenze, Typ ESV
	Power supply:	230 V / 50 Hz or 115V / 60Hz
	Power cabel:	appr. 2 m
	Dimensions (L / W / H):	350 x 155 x 210 mm
	Weight of the controlbox:	appr. 8 kg
	German coustom tarif number:	84138190

Lenze
AC Tech

SMVector - Frequency Inverter
Operating Instructions

Contents

1 Safety Information 3

2 Technical Data 6

2.1 Standards and Application Conditions 6
2.2 SMV Type Number Designation 7
2.3 Ratings 8

3 Installation 11

3.1 Dimensions and Mounting 11
3.1.1 NEMA 1 (IP31) Models ≤ 30HP (22kW) 11
3.1.2 NEMA 1 (IP31) Models > 30HP (22kW) 12
3.1.3 NEMA 4X (IP65) Models 13
3.1.4 NEMA 4X (IP65) Models with Disconnect Switch 14
3.2 Electrical Installation 15
3.2.1 Power Connections 15
3.2.1.1 Mains Connection to 120VAC Single-Phase Supply 15
3.2.1.2 Mains Connection to 240VAC Single-Phase Supply 16
3.2.1.3 Mains Connection to Three-Phase Supply 16
3.2.1.4 Motor Connection 16
3.2.1.5 Installation Recommendations for EMC Compliance 17
3.2.1.6 NEMA 4X (IP65) Input Terminal Block 17
3.2.1.7 Dynamic Brake Connections 18
3.2.2 Fuses/Cable Cross-Sections 19
3.2.3 Control Terminals 20

4 Commissioning 22

4.1 Local Keypad & Display 22
4.2 Drive Display and Modes of Operation 24
4.3 Parameter Setting 25
4.4 Electronic Programming Module (EPM) 25
4.5 Parameter Menu 26
4.5.1 Basic Setup Parameters 26
4.5.2 I/O Setup Parameters 30
4.5.3 Advanced Setup Parameters 34
4.5.4 PID Parameters 38
4.5.5 Vector Parameters 40
4.5.6 Network Parameters 42
4.5.7 Diagnostic Parameters 43
4.5.7.1 Terminal & Protection Status Display 44
4.5.7.2 Keypad Status Display 44
4.5.8 Onboard Communications Parameters 15-60HP (11-45kW) 45
4.5.9 Sequencer Parameters 46
4.5.9.1 Sequencer Flow Diagram Left 54
4.5.9.2 Sequencer Flow Diagram Right 55
4.5.9.3 Sequencer Status 56

5 Troubleshooting and Diagnostics 57

5.1 Status/Warning Messages 57
5.2 Drive Configuration Messages 58
5.3 Fault Messages 58

Appendix A 61

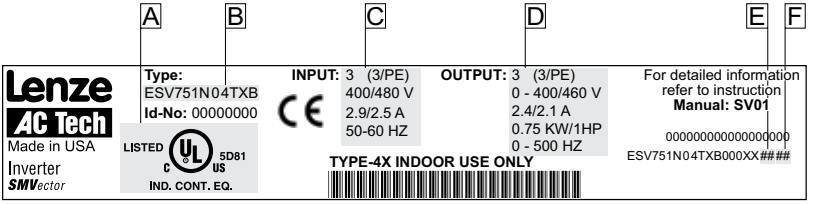
A.1 Permissable Cable Lengths 61

About These Instructions

This documentation applies to the SMV frequency inverter and contains important technical data regarding the installation, operation, and commissioning of the inverter.

These instructions are only valid for SMV frequency inverters with software revision 4.23 or higher
For version 4.23 software, the drive nameplate illustrated below would show “42” in the “F” location.

Please read these instructions in their entirety before commissioning the drive.



A	B	C	D	E	F
Certifications	Type	Input Ratings	Output Ratings	Hardware Version	Software Version

Scope of delivery	Important
• 1 SMV Inverter with EPM installed (see Section 4.4) • 1 Operating Instructions manual	After receipt of the delivery, check immediately whether the items delivered match the accompanying papers. Lenze AC Tech does not accept any liability for deficiencies claimed subsequently. Claim: • visible transport damage immediately to the forwarder. • visible deficiencies /incompleteness immediately to your Lenze AC Tech representative

Related Documents

The documentation listed herein contains information relevant to the operation of the SMVector frequency inverter. To obtain the latest documentation, visit the Technical Library at http://www.lenzeamericas.com.

Document #	Description
CMVINS01	SMVector Communications Module Installation Instruction
CMVMB401	SMVector ModBus RTU over RS485 Communications Reference Guide
CMVLC401	SMVector Lecom Communications Reference Guide
CMVCAN01	SMVector CANopen Communications Reference Guide
CMVDVN01	SMVector DeviceNet Communications Reference Guide
CMVETH01	SMVector EtherNet/IP Communications Reference Guide
CMVPFB01	SMVector PROFIBUS Communications Reference Guide
ALSV01	SMVector Additional I/O Module Installation and Operation Manual
DBV01	SMVector Dynamic Braking
PTV01	SMVector Potentiometer Install Instructions
RKV01	SMVector ESVZXK1 Remote Keypad
RKVU01	SMVector ESVZXH0 Remote Keypad (for NEMA 1 15-60HP (11-45kW) Drives)

Copyright © 2006 Lenze AC Tech Corporation

All rights reserved. No part of this manual may be reproduced or transmitted in any form without written permission from Lenze AC Tech Corporation. The information and technical data in this manual are subject to change without notice. Lenze AC Tech Corporation makes no warranty of any kind with respect to this material, including, but not limited to, the implied warranties of its merchantability and fitness for a given purpose. Lenze AC Tech Corporation assumes no responsibility for any errors that may appear in this manual.

All information given in this documentation has been carefully selected and tested for compliance with the hardware and software described. Nevertheless, discrepancies cannot be ruled out. Lenze AC Tech does not accept any responsibility nor liability for damages that may occur. Any necessary corrections will be implemented in subsequent editions. This document is printed in the United States

1 Safety Information

General

Some parts of Lenze AC Tech controllers can be electrically live and some surfaces can be hot. Non-authorized removal of the required cover, inappropriate use, and incorrect installation or operation creates the risk of severe injury to personnel and/or damage to equipment.

All operations concerning transport, installation, and commissioning as well as maintenance must be carried out by qualified, skilled personnel who are familiar with the installation, assembly, commissioning, and operation of variable frequency drives and the application for which it is being used.

Installation

Ensure proper handling and avoid excessive mechanical stress. Do not bend any components and do not change any insulation distances during transport, handling, installation or maintenance. Do not touch any electronic components or contacts. This drive contains electrostatically sensitive components, which can easily be damaged by inappropriate handling. Static control precautions must be adhered to during installation, testing, servicing and repairing of this drive and associated options. Component damage may result if proper procedures are not followed.

To ensure proper operation, do not install the drive where it is subjected to adverse environmental conditions such as combustible, oily, or hazardous vapors; corrosive chemicals; excessive dust, moisture or vibration; direct sunlight or extreme temperatures.

This drive has been tested by Underwriters Laboratory (UL) and is UL Listed in compliance with the UL508C Safety Standard. This drive must be installed and configured in accordance with both national and international standards. Local codes and regulations take precedence over recommendations provided in this and other Lenze AC Tech documentation.

The SMVector drive is considered a component for integration into a machine or process. It is neither a machine nor a device ready for use in accordance with European directives (reference machinery directive and electromagnetic compatibility directive). It is the responsibility of the end user to ensure that the machine meets the applicable standards.

Electrical Connection

When working on live drive controllers, applicable national safety regulations must be observed. The electrical installation must be carried out according to the appropriate regulations (e.g. cable cross-sections, fuses, protective earth [PE] connection). While this document does make recommendations in regards to these items, national and local codes must be adhered to.

The documentation contains information about installation in compliance with EMC (shielding, grounding, filters and cables). These notes must also be observed for CE-marked controllers. The manufacturer of the system or machine is responsible for compliance with the required limit values demanded by EMC legislation.

Application

The drive must not be used as a safety device for machines where there is a risk of personal injury or material damage. Emergency Stops, over-speed protection, acceleration and deceleration limits, etc must be made by other devices to ensure operation under all conditions.

The drive does feature many protection devices that work to protect the drive and the driven equipment by generating a fault and shutting the drive and motor down. Mains power variances can also result in shutdown of the drive. When the fault condition disappears or is cleared, the drive can be configured to automatically restart, it is the responsibility of the user, OEM and/or integrator to ensure that the drive is configured for safe operation.

Explosion Proof Applications

Explosion proof motors that are not rated for inverter use lose their certification when used for variable speed. Due to the many areas of liability that may be encountered when dealing with these applications, the following statement of policy applies:

Lenze AC Tech Corporation inverter products are sold with no warranty of fitness for a particular purpose or warranty of suitability for use with explosion proof motors. Lenze AC Tech Corporation accepts no responsibility for any direct, incidental or consequential loss, cost or damage that may arise through the use of AC inverter products in these applications. The purchaser expressly agrees to assume all risk of any loss, cost or damage that may arise from such application.

Operation

Systems including controllers must be equipped with additional monitoring and protection devices according to the corresponding standards (e.g. technical equipment, regulations for prevention of accidents, etc.). The controller may be adapted to your application as described in this documentation.

DANGER!

- After the controller has been disconnected from the supply voltage, live components and power connection must not be touched immediately, since capacitors could be charged. Please observe the corresponding notes on the controller.
- Close all protective covers and doors prior to and during operation.
- Do not cycle input power to the controller more than once every two minutes.
- For SMVector models that are equipped with a Disconnect Switch (11th character in model number is L or M), the Disconnect Switch is intended as a motor service disconnect and does not provide branch circuit protection to the inverter or motor. When servicing the motor, it is necessary to wait 3 minutes after turning this switch to the off position before working on motor power wiring as the inverter stores electrical power. To service the inverter, it is necessary to remove mains ahead of the drive and wait 3 minutes.

Safety Notifications

All safety information given in these Operating Instructions includes a visual icon, a bold signal word and a description.

Signal Word! (characterizes the severity of the danger)

NOTE (describes the danger and informs on how to proceed)

Icon	Signal Word	Meaning	Consequences if ignored
	DANGER!	Warns of hazardous electrical voltage.	Death or severe injuries.
	WARNING!	Warns of potential, very hazardous situations.	Risk of severe injury to personnel and/or damage to equipment.
	WARNING! Hot Surface	Warns of hot surface and risk of burns. Labels may be on or inside the equipment to alert people that surfaces may reach dangerous temperatures.	Risk of severe injury to personnel.
	STOP!	Warns of potential damage to material and equipment.	Damage to the controller/drive or its environment.
	NOTE	Designates a general, useful note.	None. If observed, then using the controller/ drive system is made easier.

Harmonics Notification in accordance with EN 61000-3-2, EN 61000-3-12:

Operation in public supply networks (Limitation of harmonic currents i.a.w. EN 61000-3-2, Electromagnetic Compatibility (EMC) Limits). Limits for harmonic current emissions (equipment input current up to 16A/phase).

Directive	Total Power connected to Mains (public supply)	Additional Measures Required for Compliance (2)
EN 61000-3-2	< 0.5kW	with mains choke
	0.5 ... 1kW	with active filter
	> 1kW	complies without additional measures
EN 61000-3-12	16 ... 75amp	Additional measures are required for compliance with the standard

(1) For compliance with EMC regulations, the permissable cable lengths may change.

(2) The additional measures described only ensure that the controller meets the requirements of the EN 61000-3-2. The machine/system manufacturer is responsible for the machine's compliance with the regulations.

Safety Information in accordance with EN 61800-5-1:

DANGER! Hazard of Electrical Shock
Capacitors retain charge for approximately 180 seconds after power is removed. Allow at least 3 minutes for discharge of residual charge before touching the drive.

WARNING!
- This product can cause a d.c. current in the PE conductor. Where a residual current-operated (RCD) or monitoring (RCM) device is used for protection in case of direct or indirect contact, only an RCD or RCM Type B is allowed on the supply side of this product.
- Leakage Current may exceed 3.5mA AC. The minimum size of the PE conductor shall comply with local safety regulations for high leakage current equipment.
- In a domestic environment, this product may cause radio interference in which case supplementary mitigation measures may be required.

NOTE
Control and communications terminals provide **reinforced insulation** (i.e. considered SELV or PELV, providing protection in case of direct contact) when the drive is connected to a power system rated up to 300VAC between phase to ground (PE) and the applied voltage on Terminals 16 and 17 is less than 150VAC between phase to ground. Otherwise, control and communications terminals provide **basic insulation**.

Safety Information in accordance with UL:

Note for UL approved system with integrated controllers: UL warnings are notes which apply to UL systems. The documentation contains special information about UL.

c UL us
Warnings!

- Suitable for use on a circuit capable of delivering not more than 200,000 rms symmetrical amperes, at the maximum voltage rating marked on the drive.
- Use minimum 75 °C copper wire only.
- Shall be installed in a pollution degree 2 macro-environment.
- NEMA 1 (IP31) models shall be installed in a pollution degree 2 macro-environment.
- All models are suitable for installation in a compartment handling Conditioned Air (i.e., plenum rated).

Torque Requirements (in accordance with UL) are listed in section 3.2.1, Power Connections.

2 Technical Data

2.1 Standards and Application Conditions

Conformity	CE	Low Voltage (2006/95/EC) & EMC (2004/108/EC) Directives
Approvals	UL508C	Underwriters Laboratories -Power Conversion Equipment
Input voltage phase imbalance	≤ 2%	
Supported Power Systems	TT TN	– For central grounded systems, operation is permitted without restrictions. – For corner grounded 400/500V systems, operation is possible but reinforced insulation to control circuits is compromised.
Humidity	≤ 95% non-condensing	
Temperature range	Transport	-25 … +70°C
	Storage	-20 … +70°C
	Operation	-10 … +55°C (with 2.5%/°C current derating above +40°C)
Installation height	0 - 4000m a.m.s.l.	(with 5%/1000 m current derating above 1000m a.m.s.l.)
Vibration resistance	acceleration resistant up to 1.0g	
⚠ **Earth leakage current**	> 3.5 mA to PE	
Max Permissable Cable Length (1)	<= 4.0 Hp (3.0 kW)	30 meters shielded, 60 meters un-shielded
	=> 5.0 Hp (3.7 kW)	50 meters shielded, 100 meters un-shielded.
Enclosure	IP31/NEMA 1	IP65/NEMA 4X
	NEMA 1 and NEMA 4X model enclosures are plenun rated in accordance with UL 508C and are suitable for installation in a compartment handling conditioned air.	
Protection measures against	short circuit, earth fault, phase loss, over voltage, under voltage, motor stalling, over temperature, motor overload	
Compliance with EN 61000-3-2 Requirements (2)	< 0.5kW	with mains choke
	0.5 ... 1kW	with active filter
	> 1kW	without additional measures
Compliance with EN 61000-3-12 Requirements (2)	16 ... 75amp	Additional measures required for compliance with EN 61000-3-12

Operation in public supply networks (Limitation of harmonic currents i.a.w. EN 61000-3-2, Electromagnetic Compatibility (EMC) Limits). Limits for harmonic current emissions (equipment input current up to 16A/phase).

(1) The stated cable lengths are permissible at default carrier frequencies (refer to parameter P166).

(2) The additional measures described only ensure that the controller meets the requirements of the EN 61000-3-2. The machine/system manufacturer is responsible for the machine's compliance with the regulations.

2.2 SMV Type Number Designation

The table herein describes the Type numbering designation for the SMVector Inverter models.

	ESV	152	N0	2	T	X	B

Electrical Products in the SMVector Series

Power Rating in kW:

251 = 0.25kW (0.33HP)	113 = 11.0kW (15HP)
371 = 0.37kW (0.5HP)	153 = 15.0kW (20HP)
751 = 0.75kW (1HP)	183 = 18.5kW (25HP)
112 = 1.1kW (1.5HP)	223 = 22.0kW (30HP)
152 = 1.5kW (2HP)	303 = 30.0kW (40HP)
222 = 2.2kW (3HP)	373 = 37.5kW (50HP)
302 = 3.0kW (4HP)	453 = 45.0kW (60HP)
402 = 4.0kW (5HP)	
552 = 5.5kW (7.5HP)	
752 = 7.5kW (10HP)	

Installed I/O & Communication Module(s):

C_ = CANopen (Available all models)	The "_" blank can be:
D_ = DeviceNet (Available all models)	0 = Standard Keypad
E_ = Ethernet/IP, (Available all models)	
R_ = RS-485 / ModBus /Lecom (Avail all models)	
P_ = ProfiBus-DP (Available all models)	
N_ = No Communications installed	

Input Voltage:

1 = 120 VAC (doubler output) or 240 VAC
2 = 240 VAC
4 = 400/480 VAC
6 = 600 VAC

Input Phase:

S = Single Phase Input only
Y = Single or Three Phase Input
T = Three Phase Input only

Input Line Filter

F = Integral EMC Filter
L = Integral EMC Filter and Integrated Disconnect Switch (NEMA 4X/IP65 Models only)
M = Integrated Disconnect Switch (NEMA 4X/IP65 Models only)
X = No EMC Filter/ No Disconnect Switch

Enclosure:

B = NEMA 1/IP31; Indoor only
C = NEMA 4X/IP65; Indoor only; Convection cooled
D = NEMA 4X/IP65; Indoor only; Fan cooled
E = NEMA 4X/IP65; Indoor/Outdoor; Convection cooled
F = NEMA 4X/IP65; Indoor/Outdoor; Fan cooled

NOTE
Prior to installation make sure the enclosure is suitable for the end-user environment
Variables that influence enclosure suitability include (but are not limited to) temperature, airborne contaminates, chemical concentration, mechanical stress and duration of exposure (sunlight, wind, precipitation).

2.3 Ratings

120V / 240VAC Models

Mains = 120V Single Phase (1/N/PE) (90...132V), 240V Single Phase (2/PE) (170...264V); 48...62Hz									
Type	Power		Mains Current		Output Current		Heat Loss (Watts)		
	Hp	kW	120V A	240V A	Cont (I_n) A	Max I %	N1/IP31	N4X/IP65 No filter	N4X/IP65 W/ filter
ESV251--1S--	0.33	0.25	6.8	3.4	1.7	200	24		
ESV371--1S--	0.5	0.37	9.2	4.6	2.4	200	32	32	
ESV751--1S--	1	0.75	16.6	8.3	4.2	200	52	41	
ESV112--1S--	1.5	1.1	20	10.0	6.0	200	74	74	

NOTES:

Output Current: The Output Current Maximum (%) is a percentage of the Output Current Continuous Amps (In) rating and is adjustable in parameter P171.

240VAC Models

Mains = 240V Single Phase (2/PE) (170...264V); 48...62Hz								
Type	Power		Mains Current	Output Current		Heat Loss (Watts)		
	Hp	kW	240V A	Cont (I_n) A	Max I %	N1/IP31	N4X/IP65 No filter	N4X/IP65 W/ filter
ESV251--2S--	0.33	0.25	3.4	1.7	200	20		
ESV371--2S--	0.5	0.37	5.1	2.4	200			30
ESV751--2S--	1	0.75	8.8	4.2	200			42
ESV112--2S--	1.5	1.1	12.0	6.0	200			63
ESV152--2S--	2	1.5	13.3	7.0	200			73
ESV222--2S--	3	2.2	17.1	9.6	200			97

240V Single Phase (2/PE) (170...264V), 240V Three Phase (3/PE) (170...264V); 48...62Hz									
Type	Power		Mains Current		Output Current		Heat Loss (Watts)		
	Hp	kW	1~ (2/PE) A	3~ (3/PE) A	Cont (I_n) A	Max I %	N1/IP31	N4X/IP65 No filter	N4X/IP65 W/ filter
ESV371--2Y--	0.5	0.37	5.1	2.9	2.4	200	27	26	
ESV751--2Y--	1	0.75	8.8	5.0	4.2	200	41	38	
ESV112--2Y--	1.5	1.1	12.0	6.9	6.0	200	64	59	
ESV152--2Y--	2	1.5	13.3	8.1	7.0	200	75	69	
ESV222--2Y--	3	2.2	17.1	10.8	9.6	200	103	93	

240V Three Phase (3/PE) (170...264V); 48...62Hz								
Type	Power		Mains Current	Output Current		Heat Loss (Watts)		
	Hp	kW	240V A	Cont (I_n) A	Max I %	N1/IP31	N4X/IP65 No filter	N4X/IP65 W/ filter
ESV112--2T--	1.5	1.1	6.9	6	200	64		
ESV152--2T--	2	1.5	8.1	7	200	75		
ESV222--2T--	3	2.2	10.8	9.6	200	103		
ESV402--2T--	5	4.0	18.6	16.5	200	154	139	
ESV552--2T--	7.5	5.5	26	23	200	225	167	
ESV752--2T--	10	7.5	33	29	200	274	242	
ESV113--2T--	15	11	48	42	180	485	468	
ESV153--2T--	20	15	59	54	180	614	591	

NOTES:

Output Current: The Output Current Maximum (%) is a percentage of the Output Current Continuous Amps (In) rating and is adjustable in parameter P171.

400...480VAC Models

400 ... 480V Three Phase (3/PE) (400V: 340...440V), (480V: 340...528V); 48...62Hz											
Type	Power		Mains Current		Output Current				Heat Loss (Watts)		
	Hp	kW	400V A	480V A	Cont (I_n) A		Max I %		N1/IP31	N4X/IP65 No filter	N4X/IP65 W/ filter
					400V	480V	400V	480V			
ESV371--4T--	0.5	0.37	1.7	1.5	1.3	1.1	175	200	23	21	25
ESV751--4T--	1	0.75	2.9	2.5	2.4	2.1	175	200	37	33	37
ESV112--4T--	1.5	1.1	4.2	3.6	3.5	3.0	175	200	48	42	46
ESV152--4T--	2	1.5	4.7	4.1	4.0	3.5	175	200	57	50	54
ESV222--4T--	3	2.2	6.1	5.4	5.5	4.8	175	200	87	78	82
ESV302--4T--	4	3.0	8.3	7.0	7.6	6.3	175	200			95
ESV402--4T--	5	4.0	10.6	9.3	9.4	8.2	175	200	128	103	111
ESV552--4T--	7.5	5.5	14.2	12.4	12.6	11.0	175	200	178	157	165
ESV752--4T--	10	7.5	18.1	15.8	16.1	14.0	175	200	208	190	198
ESV113--4T--	15	11	27	24	24	21	155	180	418	388	398
ESV153--4T--	20	15	35	31	31	27	155	180	493	449	459
ESV183--4T--	25	18.5	44	38	39	34	155	180	645	589	600
ESV223--4T--	30	22	52	45	46	40	155	180	709	637	647
ESV303--4T--	40	30	68	59	60	52	155	180	1020		
ESV373--4T--	50	37.5	85	74	75	65	155	180	1275		
ESV453--4T--	60	45	100	87	88	77	155	180	1530		

NOTES:

Output Current: The Output Current Maximum (%) is a percentage of the Output Current Continuous Amps (In) rating and is adjustable in parameter P171.

For 400...480 VAC models, the output current maximum (%) in the 400V column is used when P107 = 0
For 400...480 VAC models, the output current maximum (%) in the 480V column is used when P107 = 1

600VAC Models

600V Three Phase (3/PE) (425...660V); 48...62Hz								
Type	Power		Mains Current	Output Current		Heat Loss (Watts)		
	Hp	kW	A	Cont (I_n) A	Max I %	N1/IP31	N4X/IP65 No filter	N4X/IP65 W/ filter
ESV751--6T--	1	0.75	2	1.7	200	37	31	
ESV152--6T--	2	1.5	3.2	2.7	200	51	43	
ESV222--6T--	3	2.2	4.4	3.9	200	68	57	
ESV402--6T--	5	4	6.8	6.1	200	101	67	
ESV552--6T--	7.5	5.5	10.2	9	200	148	116	
ESV752--6T--	10	7.5	12.4	11	200	172	152	
ESV113--6T--	15	11	19.7	17	180	380	356	
ESV153--6T--	20	15	25	22	180	463	431	
ESV183--6T--	25	18.5	31	27	180	560	519	
ESV223--6T--	30	22	36	32	180	640	592	
ESV303--6T--	40	30	47	41	180	930		
ESV373--6T--	50	37.5	59	52	180	1163		
ESV453--6T--	60	45	71	62	180	1395		

NOTES:

Output Current: The Output Current Maximum (%) is a percentage of the Output Current Continuous Amps (In) rating and is adjustable in parameter P171.

STOP!

- For installations above 1000m a.m.s.l., derate I_n by 5% per 1000m, do not exceed 4000m a.m.s.l.
- Operation above 40°C, derate I_n by 2.5% per °C, do not exceed 55°C.

Output Current (In) derating for Carrier Frequency (P166) for NEMA 1 (IP31) Models:
- If P166=2 (8 kHz), derate I_n to 92% of drive rating
- If P166=3 (10 kHz), derate I_n to 84% of drive rating

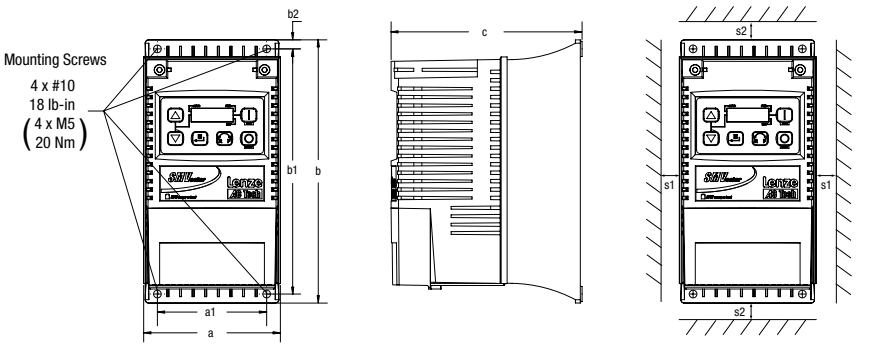
Output Current (In) derating for Carrier Frequency (P166) for NEMA 4X (IP65) Models:
- If P166=1 (6 kHz), derate I_n to 92% of drive rating
- If P166=2 (8 kHz), derate I_n to 84% of drive rating
- If P166=3 (10 kHz), derate I_n to 76% of drive rating

3 Installation

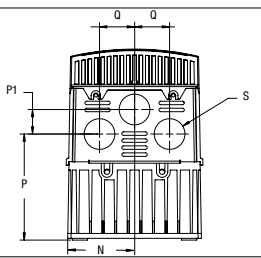
3.1 Dimensions and Mounting

WARNING!
Drives must not be installed where subjected to adverse environmental conditions such as: combustible, oily, or hazardous vapors; corrosive chemicals; excessive dust, moisture or vibration; direct sunlight or extreme temperatures.

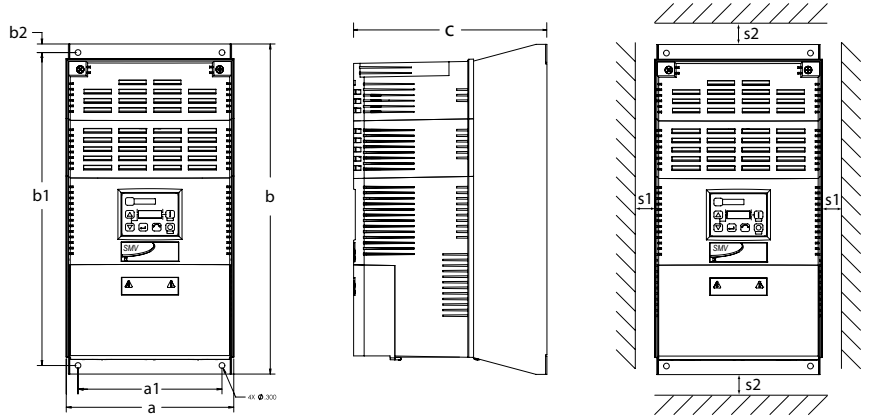
3.1.1 NEMA 1 (IP31) Models ≤ 30HP (22kW)



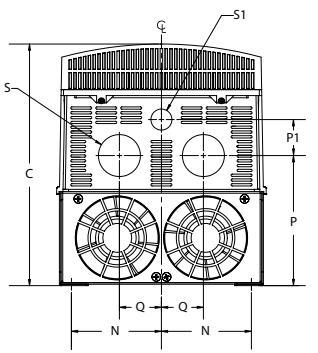
	Type	a in (mm)	a1 in (mm)	b in (mm)	b1 in (mm)	b2 in (mm)	c in (mm)	s1 in (mm)	s2 in (mm)	m lb (kg)
G1	ESV251~~~~~B; ESV371~~~~~B ESV751~~~~~B	3.90 (99)	3.12 (79)	7.48 (190)	7.00 (178)	0.24 (6)	4.35 (111)	0.6 (15)	2.0 (50)	2.0 (0.9)
G2	ESV112~~~~~B; ESV152~~~~~B ESV222~~~~~B	3.90 (99)	3.12 (79)	7.52 (191)	7.00 (178)	0.26 (7)	5.45 (138)	0.6 (15)	2.0 (50)	2.8 (1.3)
G3	ESV402~~~~~B	3.90 (99)	3.12 (79)	7.52 (191)	7.00 (178)	0.30 (8)	5.80 (147)	0.6 (15)	2.0 (50)	3.2 (1.5)
H1	ESV552~~~~~B; ESV752~~~~~B	5.12 (130)	4.25 (108)	9.83 (250)	9.30 (236)	0.26 (7)	6.30 (160)	0.6 (15)	2.0 (50)	6.0 (2.0)
J1	ESV113~~~~~B; ESV153~~~~~B ESV183~~~~~B; ESV223~~~~~B	6.92 (176)	5.75 (146)	12.50 (318)	11.88 (302)	0.31 (8)	8.09 (205)	0.6 (15)	2.0 (50)	13.55 (6.15)

Conduit Hole Dimensions	Type	N in (mm)	P in (mm)	P1 in (mm)	Q in (mm)	S in (mm)
	G1	1.84 (47)	1.93 (49)	.70 (18)	1.00 (25)	.88 (22)
	G2	1.84 (47)	3.03 (77)	.70 (18)	1.00 (25)	.88 (22)
	G3	1.84 (47)	3.38 (86)	.70 (18)	1.00 (25)	.88 (22)
	H1	2.46 (62)	3.55 (90)	.13 (3)	1.38 (35)	1.13 (29)
						.88 (22)
	J1	3.32 (84)	4.62 (117)	.73 (19)	1.40 (36)	1.31 (33)
						.88 (22)

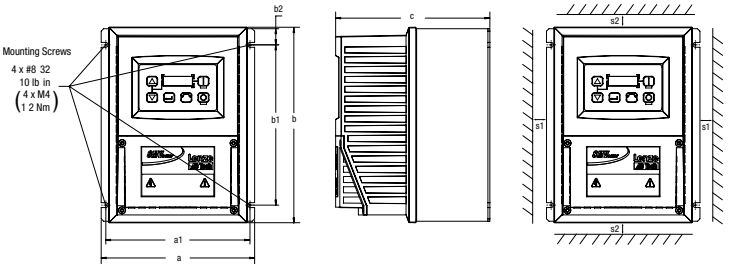
3.1.2 NEMA 1 (IP31) Models > 30HP (22kW)



	Type	a in (mm)	a1 in (mm)	b in (mm)	b1 in (mm)	b2 in (mm)	c in (mm)	s1 in (mm)	s2 in (mm)	m lb (kg)
K1	ESV303~~4~~B; ESV303~~6~~B	8.72 (221)	7.50 (190)	14.19 (360)	13.30 (338)	0.45 (11.4)	10.07 (256)	0.6 (15)	2.0 (50)	24 (10.9)
K2	ESV373~~4~~B; ESV373~~6~~B	8.72 (221)	7.50 (190)	17.19 (436)	16.30 (414)	0.45 (11.4)	10.07 (256)	0.6 (15)	2.0 (50)	31 (14.1)
K3	ESV453~~4~~B ESV453~~6~~b	8.72 (221)	7.50 (190)	20.19 (513)	19.30 (490)	0.45 (11.4)	10.07 (256)	0.6 (15)	2.0 (50)	35 (15.9)

Conduit Hole Dimensions	Type	N in (mm)	P in (mm)	P1 in (mm)	Q in (mm)	S in (mm)	S1 in (mm)
	K1	3.75 (95)	5.42 (137)	1.50 (38.1)	1.75 (44.4)	1.75 (44.4)	0.875 (22.2)
	K2	3.75 (95)	5.42 (137)	1.50 (38.1)	1.75 (44.4)	1.75 (44.4)	0.875 (22.2)
	K3	3.75 (95)	5.42 (137)	1.50 (38.1)	1.75 (44.4)	1.75 (44.4)	0.875 (22.2)

3.1.3 NEMA 4X (IP65) Models

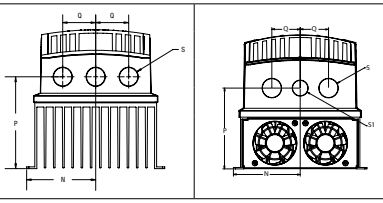


	Type	a in (mm)	a1 in (mm)	b in (mm)	b1 in (mm)	b2 in (mm)	c in (mm)	s1 in (mm)	s2 in (mm)	m lb (kg)
R1	ESV371N01SX_; ESV751N01SX_; ESV371N02YX_; ESV751N02YX_; ESV371N04TX_; ESV751N04TX_; ESV751N06TX_; ESV371N02SF_; ESV751N02SF_; ESV371N04TF_; ESV751N04TF_;	6.28 (160)	5.90 (150)	8.00 (203)	6.56 (167)	0.66 (17)	4.47 (114)	2.00 (51)	2.00 (51)	3.6 (1.63)
R2	ESV112N01SX_; ESV112N02YX_; ESV152N02YX_; ESV112N04TX_; ESV152N04TX_; ESV222N04TX_; ESV152N06TX_; ESV222N06TX_; ESV112N02SF_; ESV152N02SF_; ESV112N04TF_; ESV152N04TF_; ESV222N04TF_; ESV302N04TF_;	6.28 (160)	5.90 (150)	8.00 (203)	6.56 (167)	0.66 (17)	6.31 (160)	2.00 (51)	2.00 (51)	5.9 (2.68)
S1	ESV222N02YX_; ESV222N02SF_	7.12 (181)	6.74 (171)	8.00 (203)	6.56 (167)	0.66 (17)	6.77 (172)	2.00 (51)	2.00 (51)	7.1 (3.24)
T1	ESV552N02TX~; ESV752N02TX~ ESV752N04TX~; ESV752N06TX~; ESV752N04TF~	8.04 (204)	7.56 (192)	10.00 (254)	8.04 (204)	0.92 (23)	8.00 (203)	4.00 (102)	4.00 (102)	10.98 (4.98)
V1	ESV402N02TX_; ESV402N04TX_; ESV552N04TX_; ESV402N06TX_ ESV552N06TX_; ESV402N04TF_; ESV552N04TF_	8.96 (228)	8.48 (215)	10.00 (254)	8.04 (204)	0.92 (23)	8.00 (203)	4.00 (102)	4.00 (102)	11.58 (5.25)
W1	ESV113N02TX~; ESV153N02TX~ ESV113N04TX~; ESV153N04TX~ ESV113N04TF~; ESV153N04TF~ ESV113N06TX~; ESV153N06TX~ ESV183N04TX~; ESV183N04TF~ ESV183N06TX~	9.42 (240)	8.94 (228)	14.50 (368)	12.54 (319)	0.92 (24)	9.45 (241)	4.00 (102)	4.00 (102)	22.0 (10.0)
X1	ESV223N04TX~; ESV223N04TF~ ESV223N06TX~	9.42 (240)	8.94 (228)	18.5 (470)	16.54 (420)	0.92 (24)	9.45 (241)	4.00 (102)	4.00 (102)	25.5 (11.6)

_ = Last digit of part number: C = N4X Indoor (convection cooled) E = N4X In/Outdoor (convection cooled)

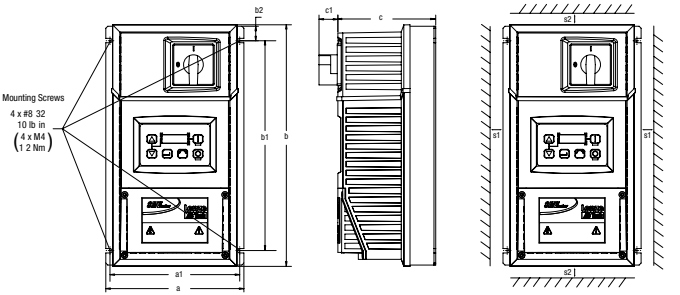
~ = Last digit of part number: D = N4X Indoor (fan cooled) F = N4X In/Outdoor (fan cooled)

Conduit Hole Dimensions



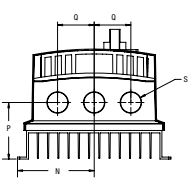
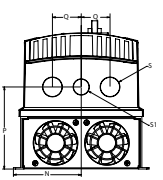
Type	N in (mm)	P in (mm)	Q in (mm)	S in (mm)	S1 in (mm)
R1	3.14 (80)	2.33 (59)	1.50 (38)	.88 (22)	n/a
R2	3.14 (80)	4.18 (106)	1.50 (38)	.88 (22)	n/a
S1	3.56 (90)	4.63 (118)	1.50 (38)	.88 (22)	n/a
T1	4.02 (102)	5.00 (127)	1.85 (47)	1.06 (27)	n/a
V1	4.48 (114)	5.00 (127)	1.85 (47)	1.06 (27)	n/a
W1	4.71 (120)	5.70 (145)	2.00 (51)	1.375 (35)	1.125 (28)
X1	4.71 (120)	5.70 (145)	2.00 (51)	1.375 (35)	1.125 (28)

3.1.4 NEMA 4X (IP65) Models with Disconnect Switch



	Type	a in (mm)	a1 in (mm)	b in (mm)	b1 in (mm)	b2 in (mm)	c in (mm)	c1 in (mm)	s1 in (mm)	s2 in (mm)	m lb (kg)
AA1	ESV371N01SM_; ESV371N02YM_; ESV371N02SL_; ESV371N04TM_; ESV371N04TL_; ESV371N06TM_; ESV751N01SM_; ESV751N02YM_; ESV751N02SL_; ESV751N04TM_; ESV751N04TL_; ESV751N06TM_;	6.28 (160)	5.90 (150)	10.99 (279)	9.54 (242)	0.66 (17)	4.47 (114)	.86 (22)	2.00 (51)	2.00 (51)	4.7 (2.13)
AA2	ESV112N01SM_; ESV112N02YM_; ESV112N02SL_; ESV112N04TM_; ESV112N04TL_; ESV152N02YM_; ESV152N02SL_; ESV152N04TM_; ESV152N04TL_; ESV152N06TM_; ESV222N04TM_; ESV222N04TL_; ESV222N06TM_; ESV302N04TL_;	6.28 (160)	5.90 (150)	10.99 (279)	9.54 (242)	0.66 (17)	6.31 (160)	.86 (22)	2.00 (51)	2.00 (51)	7.9 (3.58)
AD1	ESV222N02SL_; ESV222N02YM_;	7.12 (181)	6.74 (171)	10.99 (279)	9.54 (242)	0.66 (17)	6.77 (172)	.86 (22)	2.00 (51)	2.00 (51)	9.0 (4.08)
AB1	ESV552N02TM~; ESV752N02TM~ ESV752N04TM~; ESV752N06TM~; ESV752N04TL~	8.04 (204)	7.56 (192)	13.00 (330)	11.04 (280)	0.92 (23)	8.00 (203)	.86 (22)	4.00 (102)	4.00 (102)	13.9 (6.32)
AC1	ESV402N02TM_; ESV402N04TM_; ESV552N04TM_; ESV402N06TM_; ESV552N06TM_; ESV402N04TL_; ESV552N04TL_	8.96 (228)	8.48 (215)	13.00 (330)	11.04 (280)	0.92 (23)	8.04 204)	.86 (22)	4.00 (102)	4.00 (102)	14.7 (6.66)
AE1	ESV113N04TM~; ESV153N04TM~, ESV113N06TM~; ESV153N06TM~	9.42 (240)	8.94 (228)	14.50 (368)	12.54 (319)	0.92 (24)	9.45 (241)	0.73 (19)	4.00 (102)	4.00 (102)	23.0 (10.4)
AF1	ESV113N02TM~; ESV153N02TM~ ESV113N04TL~; ESV153N04TL~ ESV183N04TL~; ESV223N04TL~ ESV183N04TM~; ESV223N04TM~ ESV183N06TM~; ESV223N06TM~	9.42 (240)	8.94 (228)	18.5 (470)	16.54 (420)	0.92 (24)	9.45 (241)	0.73 (19)	4.00 (102)	4.00 (102)	28.5 (12.9)

_ = Last digit of part number: C = N4X Indoor (convection cooled) ~ = Last digit of part number: D = N4X Indoor (fan cooled)

Conduit Hole Dimensions		Type	N in (mm)	P in (mm)	Q in (mm)	S in (mm)	S1 in (mm)
		AA1	3.14 (80)	2.33 (59)	1.50 (38)	.88 (22)	n/a
		AA2	3.14 (80)	4.18 (106)	1.50 (38)	.88 (22)	n/a
		AD1	3.56 (90)	4.63 (118)	1.50 (38)	.88 (22)	n/a
		AB1	4.02 (102)	5.00 (127)	1.85 (47)	1.06 (27)	n/a
		AC1	4.48 (114)	5.00 (127)	1.85 (47)	1.06 (27)	n/a
		AE1	4.71 (120)	5.70 (145)	2.00 (51)	1.375 (35)	1.125 (28)
		AF1	4.71 (120)	5.70 (145)	2.00 (51)	1.375 (35)	1.125 (28)

3.2 Electrical Installation

Installation After a Long Period of Storage

STOP!
Severe damage to the drive can result if it is operated after a long period of storage or inactivity without reforming the DC bus capacitors.

If input power has not been applied to the drive for a period of time exceeding three years (due to storage, etc), the electrolytic DC bus capacitors within the drive can change internally, resulting in excessive leakage current. This can result in premature failure of the capacitors if the drive is operated after such a long period of inactivity or storage.

In order to reform the capacitors and prepare the drive for operation after a long period of inactivity, apply input power to the drive for 8 hours prior to actually operating the motor.

3.2.1 Power Connections

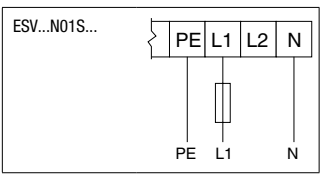
STOP!
If the kVA rating of the AC supply transformer is greater than 10 times the input kVA rating of the drive(s), an isolation transformer or 2-3% input line reactor must be added to the line side of the drive(s).

DANGER! Hazard of electrical shock!
Circuit potentials up to 600 VAC are possible. Capacitors retain charge after power is removed. Disconnect power and wait at least three minutes before servicing the drive.

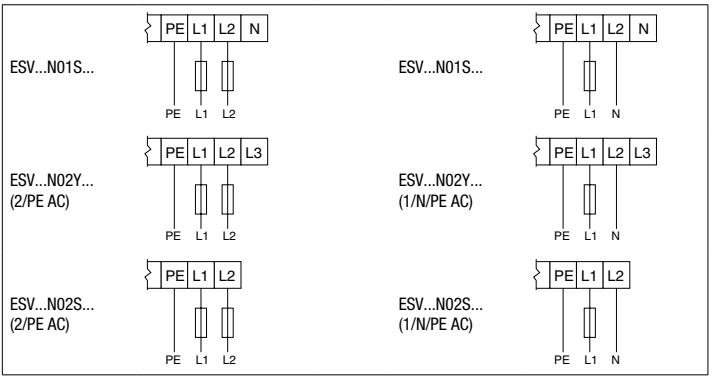
STOP!
- Verify mains voltage before connecting to drive.
- Do not connect mains power to the output terminals (U,V,W)! Severe damage to the drive will result.
- Do not cycle mains power more than once every two minutes. Damage to the drive may result.

Mains and Motor Terminations		
Type	**Torque**	**Strip Length**
<5HP	12 lb-in (1.3 Nm)	5/16 in (8mm)
ESV552xx2T, ESV752xx2T, ESV113xx4/6, ESV153xx4/6, ESV183xx6, ESV223xx6	16 lb-in (1.8 Nm)	5/16 in (8mm)
ESV552xx4Txx, ESV752xx4Txx, ESV552xx6Txx, ESV752xx6Txx	12 lb-in (1.3Nm)	0.25 in (6mm)
ESV113xx2xxx, ESV153xx2xxx, ESV183xx4xxx, ESV223xx4xxx, ESV303xx4xxx	24 lb-in (2.7 Nm)	7/16 in (10mm)
ESV373xx4xxx, ESV453xx4xxx	27 lb-in (3.05 Nm)	0.75 in (19mm)
Torque: N4X/IP65 Door Screws		
N4X/IP65	6-7 lb-in (0.67-0.79 Nm)	0.25 in (6mm)

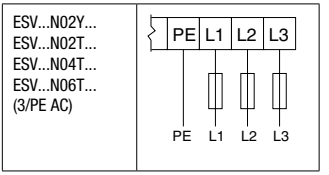
3.2.1.1 Mains Connection to 120VAC Single-Phase Supply



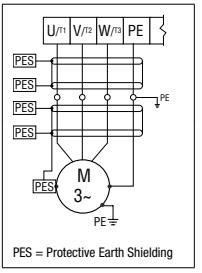
3.2.1.2 Mains Connection to 240VAC Single-Phase Supply



3.2.1.3 Mains Connection to Three-Phase Supply



3.2.1.4 Motor Connection



WARNING!
If the cable connection between the drive and the motor has an in-line contactor or circuit breaker then the drive must be stopped prior to opening/closing the contacts. Failure to do so may result in Overcurrent trips and/or damage to the inverter.

WARNING!
Leakage current may exceed 3.5 mA AC. The minimum size of the protective earth (PE) conductor shall comply with local safety regulations for high leakage current equipment.

STOP

STOP!
In the case of a Spinning Motor:

To bring free-wheeling loads such as fans to a rest before starting the drive, use the DC injection braking function. Starting a drive into a freewheeling motor creates a direct short-circuit and may result in damage to the drive.

Confirm motor suitability for use with DC injection braking.
Consult parameter P110 for starting / restarting into spinning motors.

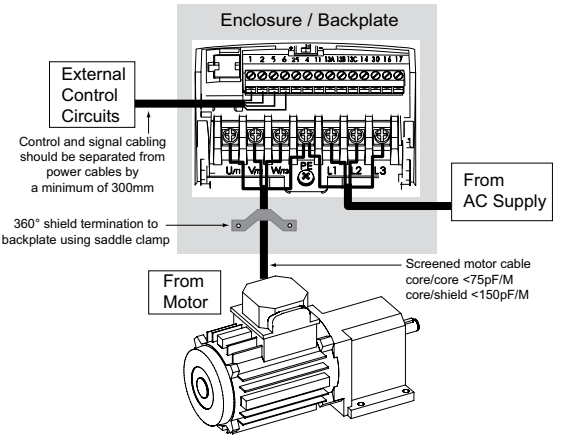
3.2.1.5 Installation Recommendations for EMC Compliance

For compliance with EN 61800-3 or other EMC standards, motor cables, line cables and control or communications cables must be shielded with each shield/screen clamped to the drive chassis. This clamp is typically located at the conduit mounting plate.

The EMC requirements apply to the final installation in its entirety, not to the individual components used. Because every installation is different, the recommended installation should follow these guidelines as a minimum. Additional equipment (such as ferrite core absorbers on power conductors) or alternative practices may be required to meet conformance in some installations.

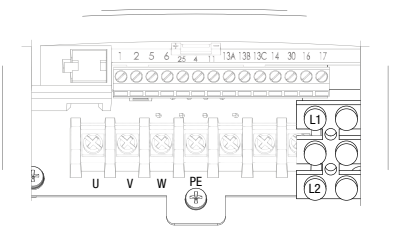
Motor cable should be low capacitance (core/core <75pF/m, core/shield <150pF/m). Filtered drives can meet the class A limits of EN 55011 and EN 61800-3 Category 2 with this type of motor cable up to 10 meters.

NOTE: Refer to Appendix A for recommended cable lengths. Any external line filter should have its chassis connected to the drive chassis by mounting hardware or with the shortest possible wire or braid.

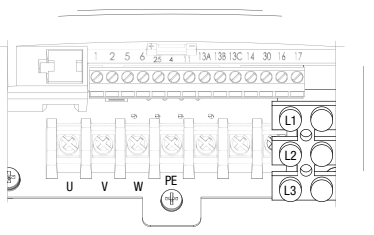

Enclosure / Backplate
External Control Circuits
Control and signal cabling should be separated from power cables by a minimum of 300mm
360° shield termination to backplate using saddle clamp
From AC Supply
From Motor
Screened motor cable
core/core <75pF/M
core/shield <150pF/M

3.2.1.6 NEMA 4X (IP65) Input Terminal Block

For NEMA 4X (IP65) models with integrated EMC filter and/or integrated line disconnect, the input terminal block is located on the right-hand side of the SMV inverter in the NEMA 4 X (IP65) enclosure. The single and three phase models are illustrated herein. Refer to paragraph 3.2.3 Control Terminals for pin out information.



Single Phase (2/PE)
With Filter and/or integrated line disconnect

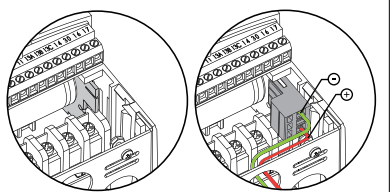
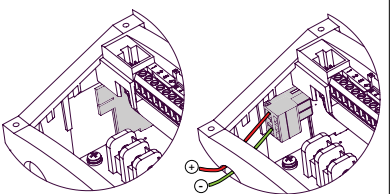


Three Phase (3/PE)
With Filter and/or integrated line disconnect

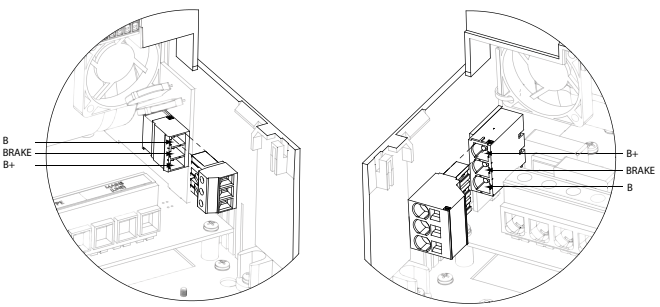
WARNING
Power remains present for up to 3 minutes on power input terminals (L1, L2 and L3) and output terminals (U, V and W) even when the disconnect switch is in the OFF position. Remove input power ahead of the drive and wait 3 minutes before removing the terminal cover.

3.2.1.7 Dynamic Brake Connections

For NEMA 1 and NEMA 4X Drives rated up to 30HP (22kW) the Dynamic Brake connections are made as illustrated herein. Refer to the SMV Dynamic Brake Instructions (DBV01) for complete information.

NEMA 1 (IP31) up to 30HP (22kW)	NEMA 4X (IP65) up to 30HP (22kW)
	

The SMV 40...60Hp (30...45kW) models include a dynamic brake transistor as standard and only require the connection of an external resistor kit for dynamic braking operation. The dynamic brake resistor connections for 40...60 Hp (30...45kW) drives are standard built-in connections as illustrated in the diagram below. In the 40Hp (30kW) model drives, the dynamic brake connector is on the right-hand side of the drive and the terminals from top to bottom are B-, BRAKE and B+. In the 50/60HP (37.5/45 kW) model drives, the dynamic brake connector is on the left-hand side of the drive and the terminals from top to bottom are B+, BRAKE and B-.



40HP (30kW) 50/60HP (37.5/45kW)

External resistor kits must be connected to terminals B+ and BRAKE (no connection to B-). Refer to the table herein for external resistor kit selection. Refer to parameter P189 for enabling the dynamic brake function in the 40...60Hp (30...45kW) models.

400/480 VAC SMV Inverter			Resistor Kit			
Type	**Hp**	**kW**	**Resistance (Ω)**	**Power (W)**	**Catalog #**	**SAP#**
ESV303**4T**	40	30	23.5	1020	841-013	13317724
ESV373**4T**	50	37	17	1400	841-015	13317626
ESV453**4T**	60	45	17	1400	841-015	13317626
600 VAC SMV Inverter			**Resistor Kit**			
Type	**Hp**	**kW**	**Resistance (Ω)**	**Power (W)**	**Catalog #**	**SAP#**
ESV303**6T**	40	30	35	1070	841-014	13317624
ESV373**6T**	50	37	24	1560	841-016	13317628
ESV453**6T**	60	45	24	1560	841-016	13317628

3.2.2 Fuses/Cable Cross-Sections

NOTE: Observe local regulations. Local codes may supersede these recommendations

Type		Recommendations				
		Fuse	Miniature circuit breaker[1]	Fuse[2] or Breaker[3] (N. America)	Input Power Wiring (L1, L2, L3, PE)	
					[mm²]	[AWG]
120V 1~ (1/N/PE)	ESV251N01SXB	M10 A	C10 A	10 A	1.5	14
	ESV371N01SXB, ESV371N01SX*	M16 A	C16 A	15 A	2.5	14
	ESV751N01SXB, ESV751N01SX*	M25 A	C25 A	25 A	4	10
	ESV112N01SXB, ESV112N01SX*	M32 A	C32 A	30A	4	10
240V 1~ (2/PE)	ESV251N01SXB, ESV251N02SXB, ESV371N01SXB, ESV371N02YXB, ESV371N02SF*	M10 A	C10 A	10 A	1.5	14
	ESV751N01SXB, ESV751N02YXB, ESV751N02SF*	M16 A	C16 A	15 A	2.5	14
	ESV112N02YXB, ESV112N02SFC, ESV112N01SXB ESV112N01SX*	M20 A	C20 A	20 A	2.5	12
	ESV152N02YXB, ESV152N02SF*	M25 A	C25 A	25 A	2.5	12
	ESV222N02YXB, ESV222N02SF*	M32 A	C32A	30 A	4	10
240V 3~ (3/PE)	ESV371N02YXB, ESV751N02YXB, ESV371N02Y_*, ESV751N02Y_*	M10 A	C10 A	10 A	1.5	14
	ESV112N02YXB, ESV152N02YXB, ESV112N02TXB, ESV152N02TXB, ESV112N02Y_*, ESV152N02Y_*	M16 A	C16 A	12 A	1.5	14
	ESV222N02YXB, ESV222N02TXB, ESV222N02YX*	M20 A	C20 A	20 A	2.5	12
	ESV402N02TXB, ESV402N02T_*	M32 A	C32 A	30 A	4.0	10
	ESV552N02TXB, ESV552N02T_~	M40 A	C40 A	35 A	6.0	8
	ESV752N02TXB, ESV752N02T_~	M50 A	C50 A	45 A	10	8
	ESV113N02TXB, ESV113N02TX~, ESV113N02TM~	M80 A	C80 A	80 A	16	6
	ESV153N02TXB, ESV153N02TX~, ESV153N02TM~	M100 A	C100 A	90 A	16	4
400V or 480V 3~(3/PE)	ESV371N04TXB ...ESV222N04TXB ESV371N04T_* ...ESV222N04T_* ESV371N04TF* ...ESV222N04TF*	M10 A	C10 A	10 A	1.5	14
	ESV302N04T_*	M16 A	C16 A	15 A	2.5	14
	ESV402N04TXB, ESV402N04T_*	M16 A	C16 A	20 A	2.5	14
	ESV552N04TXB, ESV552N04T_*	M20 A	C20 A	20 A	2.5	14
	ESV752N04TXB, ESV752N04T_~	M25 A	C25 A	25 A	4.0	10
400V or 480V 3~(3/PE)	ESV113N04TXB, ESV113N04T_~	M40 A	C40 A	40 A	4	8
	ESV153N04TXB, ESV153N04T_~	M50 A	C50 A	50 A	10	8
	ESV183N04TXB, ESV183N04T_~	M63 A	C63A	70 A	10	6
	ESV223N04TXB, ESV223N04T_~	M80 A	C80 A	80 A	16	6
	ESV303N04TXB	M100 A	C100 A	100 A	25	4
	ESV373N04TXB	M125 A	C125 A	125 A	35	2
	ESV453N04TXB	M160 A	C160 A	150 A	35	1
600V 3~(3/PE)	ESV751N06TXB ...ESV222N06TXB ESV751N06T_* ...ESV222N06T_*	M10 A	C10 A	10 A	1.5	14
	ESV402N06TXB, ESV402N06T_*	M16 A	C16 A	12 A	1.5	14
	ESV552N06TXB, ESV552N06T_*	M16 A	C16 A	15 A	2.5	14
	ESV752N06TXB, ESV752N06T_~	M20 A	C20 A	20 A	2.5	12
	ESV113N06TXB, ESV113N06TX~, ESV113N06TM~	M32 A	C32 A	30 A	4	10
	ESV153N06TXB, ESV153N06TX~, ESV153N06TM~	M40 A	C40 A	40 A	4	8
	ESV183N06TXB, ESV183N06TX~, ESV183N06TM~	M50 A	C50 A	50 A	6	8
	ESV223N06TXB, ESV223N06TX~, ESV223N06TM~	M63 A	C63 A	60 A	10	8
	ESV303N06TXB	M80 A	C80 A	70 A	16	6
	ESV373N06TXB	M100 A	C100 A	90 A	16	4
	ESV453N06TXB	M125 A	C125 A	110 A	25	2

Notes for Fuse and Cable Table:

(1) Installations with high fault current due to large supply mains may require a type D circuit breaker.
(2) UL Class CC or T fast-acting current-limiting type fuses, 200,000 AIC, preferred. Bussman KTK-R, JJN or JJS or equivalent.
(3) Thermomagnetic type breakers preferred.

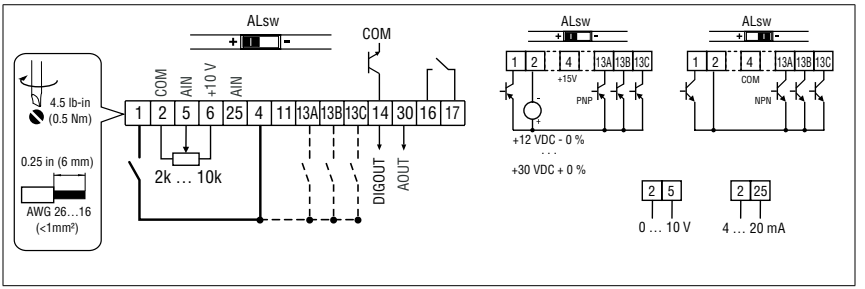
_ 11th digit of part number:	F = Integral EMC Filter
	L = Integral EMC Filter and Integrated Disconnect Switch (NEMA 4X/IP65 Models only)
	M = Integrated Disconnect Switch (NEMA 4X/IP65 Models only)
	X = No EMC Filter/ No Disconnect Switch
* = Last digit of part number:	C = N4X Indoor only (convection cooled)
	E = N4X Indoor/Outdoor (convection cooled)
~ = Last digit of part number:	D = N4X Indoor only (fan cooled)
	F = N4X Indoor/Outdoor (fan cooled)

Observe the following when using Ground Fault Circuit Interrupters (GFCIs):

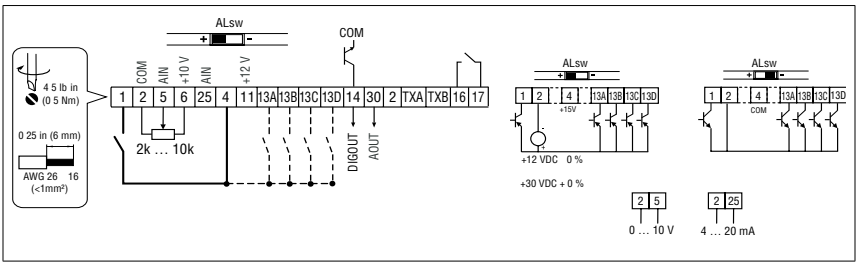
- Installation of GFCI only between supplying mains and controller.
- The GFCI can be activated by:
  - capacitive leakage currents between the cable screens during operation (especially with long, screened motor cables)
  - connecting several controllers to the mains at the same time
  - RFI filters

3.2.3 Control Terminals

Control Terminal Strip for 0.33 - 10 HP (0.25 - 7.5 kW):



Control Terminal Strip for 15HP (11 kW) and Greater Drives:



NOTE
Control and communications terminals provide basic insulation when the drive is connected to a power system rated up to 300V between phase to ground (PE) and the applied voltage on terminals 16 and 17 is less than 250 VAC between phase to phase and ground (PE).

Control Terminal Strip Descriptions

Terminal	Description	Important
1	Digital Input: Start/Stop	input resistance = 4.3kΩ
2	Analog Common	
5	Analog Input: 0...10 VDC	input resistance: >50 kΩ
6	Internal DC supply for speed pot	+10 VDC, max. 10 mA
25	Analog Input: 4...20 mA	input resistance: 250Ω
4	Digital Reference/Common	+15 VDC / 0 VDC, depending on assertion level
11	Internal DC supply for external devices	+12 VDC, max. 50 mA
13A	Digital Input: Configurable with P121	input resistance = 4.3kΩ
13B	Digital Input: Configurable with P122	
13C	Digital Input: Configurable with P123	
13D*	Digital Input: Configurable with P124	
14	Digital Output: Configurable with P142, P144	DC 24 V / 50 mA; NPN
30	Analog Output: Configurable with P150…P155	0…10 VDC, max. 20 mA
2*	Analog Common	
TXA*	RS485 TxA	
TXB*	RS485 TxB	
16	Relay output: Configurable with P140, P144	AC 250 V / 3 A DC 24 V / 2 A … 240 V / 0.22 A, non-inductive
17		

***** = Terminal is part of the terminal strip for the 15HP (11kW) and higher models only.

Assertion level of digital inputs

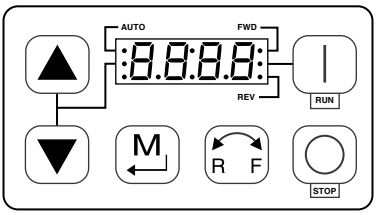
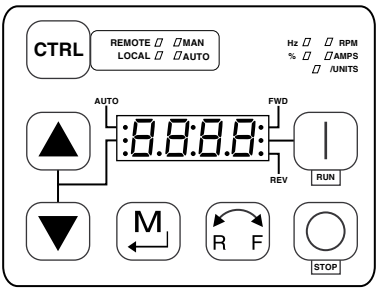
The digital inputs can be configured for active-high or active-low by setting the Assertion Level Switch (ALsw) and P120. If wiring to the drive inputs with dry contacts or with PNP solid state switches, set the switch and P120 to “High” (+). If using NPN devices for inputs, set both to “Low” (-). Active-high (+) is the default setting.

HIGH = +12 … +30 V
LOW = 0 … +3 V

NOTE
An **F_AL** fault will occur if the Assertion Level switch (ALsw) position does not match the parameter P120 setting and P100 or any of the digital inputs (P121...P124) is set to a value other than 0.

4 Commissioning

4.1 Local Keypad & Display

SMV Models: 0.33-10HP (0.25-7.5kW)	SMV Models: 15HP (11kW) and greater
	
4-Character Display	4-Character plus CTRL Display

Display	START BUTTON
	In Local Mode (P100 = 0, 4, 6), this button will start the drive.
	STOP BUTTON
	Stops the drive, regardless of which mode the drive is in. ⚠ **WARNING!** When JOG is active, the STOP button will not stop the drive!
	ROTATION
	In Local Mode (P100 = 0, 4, 6), this selects the motor rotation direction: - The LED for the present rotation direction (FWD or REV) will be on - Press R/F; the LED for the opposite rotation direction will blink - Press M within 4 seconds to confirm the change - The blinking direction LED will turn on, and the other LED will turn off When rotation direction is changed while the drive is running, the commanded direction LED will blink until the drive is controlling the motor in the selected direction. Rotation is set in P112. When P112 = 0, rotation is forward only. When P112 = 1 rotation is forward and reverse.
	MODE
	Used to enter/exit the Parameter Menu when programming the drive and to enter a changed parameter value.
	UP AND DOWN BUTTONS
	Used for programming and can also be used as a reference for speed, PID setpoint, or torque setpoint. When the ▲ and ▼ buttons are the active reference, the middle LED on the left side of the display will be on.

Display	INDICATING LEDs (on 4-character display)
	FWD LED: Indicate the present rotation direction is forward. Refer to ROTATION description above.
	REV LED: Indicate the present rotation direction is reverse. Refer to ROTATION description above.
	AUTO LED: Indicates that the drive has been put into Auto mode from one of the TB13 inputs (P121…P124 set to 1…7). Indicates that PID mode is active (if PID mode is enabled). Indicates that sequencer mode is active (if sequencer mode is enabled).
	RUN LED: Indicates that the drive is running.
	▲ ▼ LED: Indicates that the ▲ ▼ are the active reference.
	NOTE If the keypad is selected as the auto reference (P121…P124 is 6) and the corresponding TB-13 input is closed, the AUTO LED and ▲ ▼ LEDs will both be on.
	FUNCTIONS THAT FOLLOW ARE APPLICABLE TO SMV DRIVES 15HP (11kW) AND HIGHER
CTRL	**CTRL** The CTRL pushbutton selects the start and speed reference control sources for the drive. Press [M] mode button to accept the new control mode selection.

CTRL LEDs		START CONTROL	REFERENCE CONTROL
REMOTE MAN LOCAL AUTO	[LOCAL] [MAN]	Keypad	P101 Settings
REMOTE MAN LOCAL AUTO	[LOCAL] [AUTO]	Keypad	Terminal 13x Settings
REMOTE MAN LOCAL AUTO	[REMOTE] [MAN]	Terminal Strip	P101 Settings
REMOTE MAN LOCAL AUTO	[REMOTE] [AUTO]	Terminal Strip	Terminal 13x Settings
If P100 = 6 the CTRL button is used to toggle start control between the terminal strip [REMOTE] and the keypad [LOCAL]		- REM/LOC LED indicating the present start control source is ON - Press [CTRL]; the LED for other start control source will blink - Press [M] within 4 sec to confirm the change - Blinking LED will turn ON (the other LED will turn OFF)	
If P113 = 1 the CTRL button is used to toggle reference control between the TB-13x setup [AUTO] and P101 [MANUAL]		- AUT/MAN LED indicating present reference control is ON - Press [CTRL]; the other reference control will blink - Press [M] within 4 sec to confirm change - Blinking LED will turn ON (the other LED will turn OFF)	
If P100 = 6 and P113 = 1, it is possible to change the start and reference control sources at the same time			

Display	START CONTROL	
	The REMOTE/LOCAL LEDs indicate the current start control source. If the start control source is a remote keypad or the network, then both LEDs will be OFF.	
	REFERENCE CONTROL	
	The AUTO/MANUAL LEDs indicate the current reference control source.	
	IF P113 = 0 or 2, the AUTO/MANUAL LEDs will match the AUTO LED on the 4-character display. IF P113 = 0 and no AUTO reference has been setup on the terminal strip, the MANUAL LED will turn ON and the AUTO LED will turn OFF.	
	IF P113 = 1, the AUTO/MANUAL LEDS show the commanded reference control source as selected by the [CTRL] button. If the [CTRL] button is used to set the reference control source to AUTO but no AUTO reference has been setup on the terminal strip, reference control will follow P101 but the AUTO LED will remain ON.	
	UNITS LEDs	
	HZ: current display value is in Hz	In Speed mode, if P178 = 0 then HZ LED will be ON. If P178 > 0, the Units LEDs follow the setting of P177 when the drive is in run (non-programming) mode. In Torque mode, the HZ LED will be ON when the drive is in run (non-programming) mode. In Pid mode, the Units LEDs follow the setting of P203 when the drive is in run (non-programming) mode. If P179 > 0, the Units LEDs will show the unit of the diagnostic parameter that is being displayed.
	%: current display value is in %	
	RPM: current display value is in RPM	
	AMPS: current display value is in Amps	
	/UNITS current display value is a per unit (i.e./sec, /min, /hr, etc.)	

4.2 Drive Display and Modes of Operation

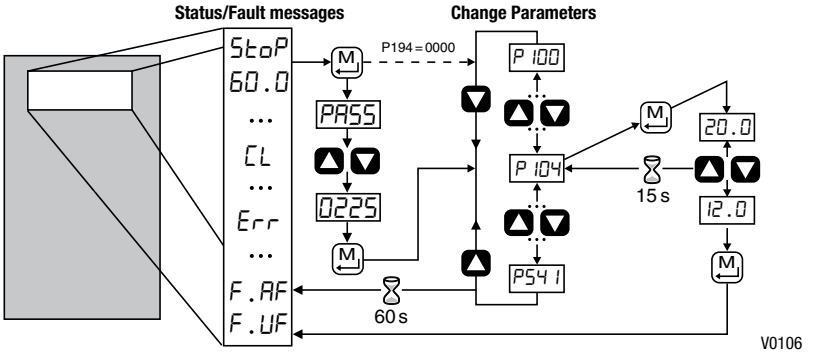
Speed Mode Display
In the standard mode of operation, the drive frequency output is set directly by the selected reference (keypad, analog reference, etc.). In this mode, the drive display will show the drive's output frequency.

PID Mode Display
When the PID mode is enabled and active, the normal run display shows the actual PID setpoint. When PID mode is not active, the display returns to showing the drive's output frequency.

Torque Mode Display
When the drive is operating in Vector Torque mode, the normal run display shows the drive's output frequency.

Alternate (Run-Screen) Display
When P179 (Run Screen Display) is set to a value other than 0, one of the diagnostic parameters (P501…P599) is displayed. Example: if P179 is set to 1, then diagnostic parameter P501 (Software version) is displayed. If P179 =2, then P502 (Drive ID) is displayed.

4.3 Parameter Setting



4.4 Electronic Programming Module (EPM)

The EPM contains the drives operational memory. Parameter settings are stored in the EPM and setting changes are made to the "User settings" in the EPM.

An optional EPM Programmer (model EEPM1RA) is available that allows:

- An EPM to be copied directly to another EPM.
- An EPM to be copied to the memory of the EPM Programmer.
- Stored files can be modified in the EPM Programmer.
- Stored files can be copied to another EPM.

EPM Module in SMV Drive

As the EPM Programmer is battery operated, parameter settings can be copied to an EPM and inserted into a drive without power being applied to the drive. This means that the drive will be fully operational with the new settings on the next application of power.

Additionally, when the drives parameter settings are burned into an EPM with the EPM Programmer, the settings are saved in two distinct locations; the "User settings" and the "OEM default settings". While the User settings can be modified in the drive, the OEM settings cannot. Thus, the drive can be reset not only to the "factory" drive default settings (shown in this manual), but can be set to the Original Machine settings as programmed by the OEM.

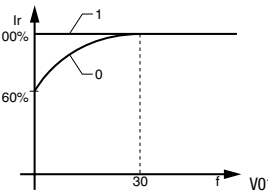
The user area contents of the EPM are what are copied into the OEM space by the EPM programmer. When parameter modifications are made to the drive and then a copy made via the EPM Programmer, these are the settings that will be available by the OEM selections from P199. The EPM Programmer is the only way to load the OEM area of the EPM.

While the EPM can be removed for copying or to use in another drive, it must be installed for the drive to operate (a missing EPM will trigger an F_F I fault)

4.5 Parameter Menu

4.5.1 Basic Setup Parameters

Code		Possible Settings		IMPORTANT
No.	Name	Default	Selection	
P 100	Start Control Source	0	0 Local Keypad	Use RUN button on front of drive to start
			1 Terminal Strip	Use start/stop circuit wired into the terminal strip. Refer to section 3.2.3
			2 Remote Keypad Only	Use RUN button on optional Remote Keypad to start
			3 Network Only	• Start command must come from network (Modbus, CANopen, etc) • SMV models <15HP (11kW) require optional communication module (refer to the network module documentation). • Must also set one of the TB-13 inputs to 9 (Network Enable); see P121...P124
			4 Terminal Strip or Local Keypad	Allows start control to be switched between terminal strip and local keypad using one of the TB-13 inputs. See note below.
			5 Terminal Strip or Remote Keypad	Allows start control to be switched between terminal strip and optional remote keypad using one of the TB-13 inputs. See Note below
			6 CTRL button select	Allows start control to be switched between terminal strip and local keypad using the CTRL button. **NOTE:** P100 Selection 6 is applicable to SMV 15HP (11kW) and higher models only.
		⚠	**WARNING!** P100 = 0 disables TB-1 as a STOP input! STOP circuitry may be disabled if parameters are reset back to defaults (see P199)	
		ℹ	**NOTE** • P100 = 4, 5: To switch between control sources, one of the TB-13 inputs (P121...P124) must be set to 08 (Control Select); TB-13x OPEN (or not configured): Terminal strip control TB-13x CLOSED: Local (P100 = 4) or Remote (P100 = 5) keypad • P100 = 0, 1, 4, 6: Network can take control if P121...P124 = 9 and the corresponding TB-13x input is CLOSED. • The STOP button on the front of the drive is always active except in JOG mode. • TB-1 is an active STOP input if P100 is set to a value other than 0. • An F_AL fault will occur if the Assertion Level switch (ALsw) position does not match the P120 setting and P100 is set to a value other than 0.	
P 101	Standard Reference Source	0	0 Keypad (Local or Remote)	Selects the default speed or torque reference when no Auto Reference is selected using the TB-13 inputs.
			1 0-10 VDC	
			2 4-20 mA	
			3 Preset #1 (P131)	
			4 Preset #2 (P132)	
			5 Preset #3 (P133)	
			6 Network	
			7 Preset Sequence Segment #1 (P710)	Selections 7, 8 & 9 are not valid for PID setpoint or torque reference.
			8 Preset Sequence Segment #2 (P715)	
			9 Preset Sequence Segment #3 (P720)	

Code		Possible Settings				IMPORTANT
No.	Name	Default	Selection			
P 102	Minimum Frequency	0.0	0.0	{Hz}	P103	• P102, P103 are active for all speed references • When using an analog speed reference, also see P160, P161
P 103	Maximum Frequency	60.0	7.5	{Hz}	500	
			NOTE • P103 cannot be set below Minimum Frequency (P102) • To set P103 above 120 Hz: - Scroll up to 120 Hz; display shows H iFr (flashing). - Release ▲ button and wait one second. - Press ▲ button again to continue increasing P103.			
		WARNING! Consult motor/machine manufacturer before operating above rated frequency. Overspeeding the motor/machine may cause damage to equipment and injury to personnel!				
P 104	Acceleration Time 1	20.0	0.0	{s}	3600	• P104 = time of frequency change from 0 Hz to P167 (base frequency) • P105 = time of frequency change from P167 to 0 Hz • For S-ramp accel/decel, adjust P106
P 105	Deceleration Time 1	20.0	0.0	{s}	3600	
		EXAMPLE: IF P103 = 120 Hz, P104 = 20.0 s and P167 (base frequency) = 60 Hz; then the rate of frequency change from 0 Hz to 120 Hz = 40.0 s				
P 106	S-Ramp Integration Time	0.0	0.0	{s}	50.0	• P106 = 0.0: Linear accel/decel ramp • P106 > 0.0: Adjusts S-ramp curve for smoother ramp
P 107 (1)	Line Voltage Selection	1*	0 Low (120, 200, 400, 480VAC) 1 High (120, 240, 480, 600VAC)			* The default setting is 1 for all drives except when using "Reset to 50Hz default settings" (Parameter P199, selection 4) with 480V models. In this case, the default setting is 0.
P 108	Motor Overload	100	30	{%}	100	P108 = motor current rating x 100 SMV output rating Example: if motor = 3amps and SMV = 4amps, then P108 = 75%
			NOTE Do not set above rated motor current as listed on the motor dataplate. The motor thermal overload function of the SMV is UL approved as a motor protection device. Cycling power after an overload fault could result in significantly reducing the motor life.			
P 109	Motor Overload Type	0	0 Speed Compensation 1 No Speed Compensation Example: Motor is cooled by forced ventilation as apposed to shaft mounted, self cooling fans.			

(1) Any changes to this parameter will not take effect until the drive is stopped.

Code		Possible Settings		IMPORTANT
No.	Name	Default	Selection	
P110	Start Method	0	0 Normal	
			1 Start on Power-up	Drive will automatically start when power is applied.
			2 Start with DC Brake	When start command is applied, drive will apply DC braking according to P174, P175 prior to starting the motor
			3 Auto Restart	Drive will automatically restart after faults, or when power is applied.
			4 Auto Restart with DC Brake	Combines settings 2 and 3
			5 Flying Start/Restart - Type 1	• Drive will automatically restart after faults, or when power is applied. • After 3 failed attempts, drive will Auto Restart with DC brake. • P110 = 5, 7: Performs speed search, starting at Max Frequency (P103) • P110 = 6, 8: Performs speed search, starting at the last output frequency prior to faulting or power loss • If P111 = 0, a flying START is performed when a start command is applied. • P110 = 7,8: Utilizes P280/281 to set Max Current Level and Decel Time for restart
			6 Flying Start/Restart - Type 1	
			7 Flying Start /Restart - Type 2 for 2-pole motors requiring a flying restart	
			8 Flying Start/Restart - Type 2 for 2-pole motors requiring a flying restart	
			NOTE • P110 = 0, 2: Start command must be applied at least 2 seconds after power-up; F_UF fault will occur if start command is applied too soon. • P110 = 1, 3…6: For automatic start/restart, the start source must be the terminal strip and the start command must be present. • P110 = 2, 4…6: If P175=999.9, dc braking will be applied for 15s. • P110 = 3…6: Drive will attempt 5 restarts; if all restart attempts fail, drive displays LC (fault lockout) and requires manual reset. • P110 = 5, 6: If drive cannot catch the spinning motor, drive will trip into F_rF fault. • P110 = 5, 6: If drive trips into F_OF fault, try P110 = 7 or 8.	
	WARNING! Automatic starting/restarting may cause damage to equipment and/or injury to personnel! Automatic starting/restarting should only be used on equipment that is inaccessible to personnel.			
P111	Stop Method	0	0 Coast	Drive's output will shut off immediately upon a stop command, allowing the motor to coast to a stop
			1 Coast with DC Brake	The drive's output will shut off and then the DC Brake will activate (refer to P174, P175)
			2 Ramp	The drive will ramp the motor to a stop according to P105 or P126.
			3 Ramp with DC Brake	The drive will ramp the motor to 0 Hz and then the DC Brake will activate (refer to P174, P175)
P112	Rotation	0	0 Forward Only	If PID mode is enabled, reverse direction is disabled (except for Jog).
			1 Forward and Reverse	

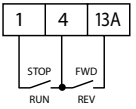
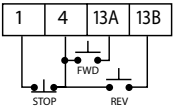
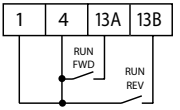
Code		Possible Settings		IMPORTANT
No.	Name	Default	Selection	
P113	Auto/Manual Control	0	0 Terminal Strip Control	The reference is dictated by the settings and state of the TB-13x terminals. If no AUTO reference has been setup on the terminal strip then reference control is dictated by P101.
			1 Auto/Manual (CTRL button select)	Allows the reference to be switched between auto and manual using the CTRL pushbutton on the drive keypad. If the CTRL pushbutton has selected AUTO reference but no AUTO reference has been setup on the terminal strip, then reference control is dictated by P101.
			2 Manual Control Only	Reference is dictated by P101 regardless of any AUTO source that may be selected by the TB-13x terminals.
		ℹ	**NOTE** P113 is applicable to SMV 15HP (11kW) and higher models only.	
P115	MOP Speed Initialization at Power-Up	0	0 Set to last MOP speed at power up	Output frequency at power-up = last MOP speed
			1 Set to 0.0Hz at power up	Output frequency at power-up = 0Hz
			2 Set to Preset #3 (P133) at power up	Output frequency at power-up = P133

4.5.2 I/O Setup Parameters

Code		Possible Settings		IMPORTANT
No.	Name	Default	Selection	
P 120	Assertion Level	2	1 Low 2 High	P120 and the Assertion Level switch must both match the desired assertion level unless P100, P121…P124 are all set to 0. Otherwise an F.AL fault will occur.
P 121 P 122 P 123 P 124	TB-13A Digital Input TB-13B Digital Input (Priority > TB13A) Same as TB13A except: 3 = Preset #2 23 = Seq Seg, #2 TB-13C Digital Input (Priority > TB13B, A) Same as TB13A except: 3 = Preset #3 23 = Seq Seg, #4 TB-13D* Digital Input (Priority > TB13C, B, A) Same as TB13A except: 3 = Preset #4 23 = Seq Seg, #8 **NOTE: P124** is applicable to SMV 15HP (11kW) and higher models only	0	0 None	Disables input
			1 AUTO Reference: 0-10 VDC	For frequency mode, see P160...P161, For PID mode, see P204…P205, For vector torque mode, see P330
			2 AUTO Reference: 4-20 mA	
			3 AUTO Reference: Preset #1 * 13D: 3 = Reserved	For frequency mode see P131...P137, For PID mode, see P231…P233, For torque mode see, P331…P333
			4 AUTO Reference: MOP Up	• Normally open: Close input to increase or decrease speed, PID or torque setpoint. • MOP Up is not active while in STOP
			5 AUTO Reference: MOP Down	
			6 AUTO Reference: Keypad	
			7 AUTO Reference: Network	
			8 Control Select	Use when P100 = 4, 5 to switch between terminal strip control and local or remote keypad control.
			9 Network Enable	Required to start the drive through the network.
			10 Reverse Rotation	Open = Forward Closed = Reverse
			11 Start Forward	Refer to Note for typical circuit
			12 Start Reverse	
			13 Run Forward	Refer to Note for typical circuit
			14 Run Reverse	
			15 Jog Forward	Jog Forward speed = P134
			16 Jog Reverse	Jog Reverse speed = P135 ⚠ Active even if P112 = 0
			17 Accel/Decel #2	Refer to P125, P126
			18 DC Brake	Refer to P174; close input to override P175
			19 Auxiliary Ramp to Stop	Normally closed: Opening input will ramp drive to STOP according to P127, even if P111 is set to Coast (0 or 1).
			20 Clear Fault	Close to reset fault
			21 External Fault F_EF	Normally closed circuit; open to trip
			22 Inverse External Fault F_EF	Normally open circuit; close to trip
			23 AUTO Ref: Sequence Segment #1	Works in Speed Mode only
			24 Start Sequence	
			25 Step Sequence	Transition from non-asserted to asserted state
			26 Suspend Sequence	

⚠ **WARNING**
Jog overrides all STOP commands! To stop the drive while in Jog mode, the Jog input must be deactivated or a fault condition induced.

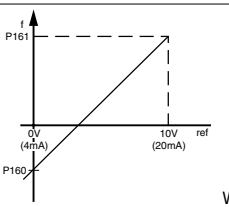
⚠ **WARNING**
If the input defined to "Start Sequence" is opened during a sequence, the drive will exit sequencer mode and will run at the specified standard or alternate speed source (dependent on drive configuration).

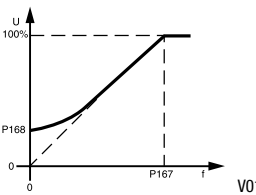
Code No.	Name	Possible Settings Default	Selection			IMPORTANT
	NOTE • When input is activated, settings 1...7 override P101 • When TB-13A...TB-13D are configured for Auto References other than MOP, TB-13D overrides TB-13C, TB-13C overrides TB-13B and TB-13B overrides TB-13A. Any other Auto Reference will have priority over MOP. • Settings 10...14 are only valid in Terminal Strip mode (P100 = 1, 4, 5, 6) • If Start/Run/Jog Forward and Start/Run/Jog Reverse are both activated, drive will STOP • If Jog input is activated while drive is running, the drive will enter Jog mode; when Jog input is deactivated, drive will STOP • An **F_AL** fault will occur if the Assertion Level switch (ALsw) position does not match the P120 setting and any of the digital inputs (P121...P124) are set to a value other than 0. • An **F_IL** fault will occur under the following conditions: - TB-13A...TB-13D settings are duplicated (each setting, except 0, 3 and 23, can only be used once) - One input is set to "MOP Up" and another is not set to "MOP Down", or vice-versa. - One input is set to 10 and another input is set to 11…14. - One input is set to 11 or 12 and another input is set for 13 or 14. • Typical control circuits are shown below: - If any input is set to 10, 12 or 14, P112 must be set to 1 for Reverse action to function. Run / Stop with Direction P121 = 10  Start Forward / Start Reverse P121 = 11, P122 = 12  Run Forward / Run Reverse P121 = 13, P122 = 14  					
P125	Acceleration Time 2	20.0	0.0	{s}	3600	• Selected using TB-13A...TB-13D (P121... P124 = 17) • For S-ramp accel/decel, adjust P106
P126	Deceleration Time 2	20.0	0.0	{s}	3600	
P127	Deceleration Time for Auxiliary Ramp to Stop	20.0	0.0	{s}	3600	• Selected using TB-13A...TB-13D (P121... P124 = 19). • For S-ramp accel/decel, adjust P106 • Once executed, this ramp time has priority over P105 and P126.
P129	Automatic Accel/ Decel rate switch threshold	0.0	0.0	{Hz}	1000	If Actual Frequency < P129 Use Accel/decel time #2 (P125/P126) If Actual Frequency > P129 Use Accel/decel time #1 (P104/P105)
P131	Preset Speed #1	0.0	0.0	{Hz}	500	PRESET SPEED / 13A / 13B / 13C / 13D 1: X -- -- -- 2: -- X -- -- 3: -- -- X -- 4: X X -- -- 4 (alternate): -- -- -- X 5: X -- X -- 6: -- X X -- 7: X X X -- 8 (alternate): -- X -- X 8 (alternate: -- -- X X • Speed setting is used by P158 • 13D available on 15HP (11kW) & higher drives.
P132	Preset Speed #2	0.0	0.0	{Hz}	500	
P133	Preset Speed #3	0.0	0.0	{Hz}	500	
P134	Preset Speed #4	0.0	0.0	{Hz}	500	
P135	Preset Speed #5	0.0	0.0	{Hz}	500	
P136	Preset Speed #6	0.0	0.0	{Hz}	500	
P137	Preset Speed #7	0.0	0.0	{Hz}	500	
P138	Preset Speed #8	0.0	0.0	{Hz}	500	

Code		Possible Settings		IMPORTANT
No.	Name	Default	Selection	
P140	Relay Output TB-16, 17	0	0 None	Disables the output
			1 Run	Energizes when the drive is running
			2 Reverse	Energizes when reverse rotation is active
			3 Fault	De-energizes when the drive trips, or power is removed
			4 Inverse Fault	Energizes when the drive trips
			5 Fault Lockout	P110 = 3...6: De-energizes if all restart attempts fail
			6 At Speed	Energizes when output frequency = commanded frequency
			7 Above Preset Speed #6	Energizes when output frequency > P136
			8 Current Limit	Energizes when motor current = P171
			9 Follower Loss (4-20 mA)	Energizes when 4-20 mA signal is < P164
			10 Loss of Load	Energizes when motor load drops below P145; Refer to P146 also
			11 Local Keypad Control Active	Energizes when the selected source is active for start control
			12 Terminal Strip Control Active	
			13 Remote Keypad Control Active	
			14 Network Control Active	
			15 Standard Reference Active	Energizes when P101 reference is active
			16 Auto Reference Active	Energizes when Auto Reference is activated using TB-13 input; refer to P121...P124
			17 Sleep Mode Active	Refer to P240...P242
			18 PID Feedback < Min. Alarm	Energizes when PID feedback signal < P214
			19 Inverse PID Feedback < Min. Alarm	De-energizes when PID feedback signal < P214
			20 PID Feedback > Max Alarm	Energizes when PID feedback signal > P215
			21 Inverse PID Feedback > Max Alarm	De-energizes when PID feedback signal > P215
			22 PID Feedback within Min/Max Alarm range	Energizes when PID feedback signal is within the Min/Max Alarm range; refer to P214, P215
			23 PID Feedback outside Min/Max Alarm range	Energizes when PID feedback signal is outside the Min/Max Alarm range; refer to P214, P215
			24 Reserved	
			25 Network Controlled	SMV models < 15HP (11kW) require an optional communication module (refer to the network module documentation).
			26 Loss of 0-10V Input	Energizes when 0-10V signal is < P158
			27 Sequencer Controlled	State set in individual sequencer segments
			28 Sequencer Active	
			29 Sequencer Suspended	
			30 Sequence Done	End Sequence
			31 Output Frequency = 0.0Hz	Output inactive
P142	TB-14 Output	0	0...23 (same as P140)	
			24 Dynamic Braking	For use with Dynamic Braking option
			25...31 (same as P140)	

Code		Possible Settings				IMPORTANT
No.	Name	Default	Selection			
P144	Digital Output Inversion		P144 / Invert P142 / Invert P140 0 / NO / NO 1 / NO / YES 2 / YES / NO 3 / YES / YES			Used to invert the selections for P140 (Relay Output) and P142 (TB-14 Output). EXAMPLE: When P140 = 6 (AT SPEED), the relay is energized when output frequency = commanded frequency. IF P144=1 or 3, then P140 is inverted (INVERSE AT SPEED) and the relay is energized when the output frequency does **not** equal the command frequency.
			NOTE Inverting P140 or P142 when the parameter is set to NONE (0) will result in the output being energized continuously.			
			NOTE For SMVector drives rated at 0.33 to 10 HP (0.25 to 7.5 kW), P144 is only available with software versions 3.0 and higher (refer to P501).			
P145	Loss of Load Threshold	0	0	{%}	200	P140, P142 = 10: Output will energize if motor load falls below the P145 value longer than the P146 time
P146	Loss of Load Delay	0.0	0.0	{s}	240.0	
P149	Analog Output Offset	0.0	0	{%}	100	Scaled value. Example: P149 = 10%, Scaled variable = freq, P150 = 1, P152 = 60Hz; then TB30 = 0VDC below 6Hz
P150	TB-30 Output	0	0 None			2-10 VDC signal can be converted to 4-20 mA with a total circuit impedance of 500 Ω
			1 0-10 VDC Output Frequency			
			2 2-10 VDC Output Frequency			
			3 0-10 VDC Load			
			4 2-10 VDC Load			
			5 0-10 VDC Torque			
			6 2-10 VDC Torque			
			7 0-10 VDC Power (kW)			
			8 2-10 VDC Power (kW)			
			9 Network Controlled			SMV models < 15HP (11kW) require an optional communication module (refer to the network module documentation).
			10 Sequencer Controlled			Value set in individual sequencer segments
P152	TB-30 Scaling: Frequency	60.0	3.0	{Hz}	2000	If P150 = 1 or 2, sets the frequency at which output equals 10 VDC
P153	TB-30 Scaling: Load	200	10	{%}	500	If P150 = 3 or 4, sets the Load (as a percent of drive current rating) at which output equals 10 VDC.
P154	TB-30 Scaling: Torque	100	10	{%}	1000	If P150 = 5 or 6, sets the Torque (as a percent of motor rated torque) at which output equals 10 VDC
P155	TB-30 Scaling: Power (kW)	1.0	0.1	{kW}	200.0	If P150 = 7 or 8, sets the power at which output equals 10 VDC

4.5.3 Advanced Setup Parameters

Code		Possible Settings				IMPORTANT
No.	Name	Default	Selection			
P156	Analog Inputs Configuration	0	0 TB5: (0-10 VDC); TB25: (4-20mA) 1 TB5: (0 - 5 VDC); TB25: (4-20mA) 2 TB5: (2 - 10 VDC); TB25: (4-20mA) 4 TB5: (0-10 VDC); TB25: (0-20mA) 5 TB5: (0 - 5 VDC); TB25: (0-20mA) 6 TB5: (2 - 10 VDC); TB25: (0-20mA)			
P157	TB5 (0-10V) Analog Input Monitoring Action	0	0 No Action 1 If TB5 < P158 - Trip Fault F_FAU 2 If TB5 < P158 - Run Preset #8 3 If TB5 < P158 - Run Preset Seg. #16 4 If TB5 > P158 - Trip Fault F_FAU 5 If TB5 > P158 - Run Preset #8 6 If TB5 > P158 - Run Preset Seg. #16			Selects the reaction to a loss of the 0-10V signal at TB5 500ms is the minimum time above/below Monitoring Level (P158) before triggering the drive to trip or run at a preset speed. For P157 = 3 or 6, the accel/decel time is set in P786. **NOTE:** P157 has priority over P163 and TB-13 presets/auto references (P121-P124)
P158	TB5 (0-10V) Analog Input Monitoring Level (ML)	0.0	-10.0	{VDC}	10.0	Negative input voltage is not currently supported.
P159	0-10V Analog Input Deadband	0.0	0	{VDC}	10.0	Not active if [-10 to +10 VDC] option is selected.
P160	Speed at Minimum Signal	0.0	-999.0	{Hz}	1000	 V0111
P161	Speed at Maximum Signal	60.0	-999.0	{Hz}	1000	
			NOTE • P160 sets the output frequency at 0% analog input • P161 sets the output frequency at 100% analog input • P160 or P161 < 0.0 Hz: For scaling purposes only; does not indicate opposite direction! • P160 > P161: Drive will react inversely to analog input signal			
P162	Analog Input Filter	0.01	0.00	{s}	10.00	• Adjusts the filter on the analog inputs (TB-5 and TB-25) to reduce the effect of signal noise • The P162 delay time will affect the response time of diagnostic parameters (P520-P523).
P163	TB-25 (4-20mA) Analog Input Monitoring Action	0	0 No Action 1 If TB25 < P164 - Trip Fault F_FaL 2 If TB25 < P164 - Run Preset #7 3 If TB25 < P164 - Run Preset Seg. #15 4 If TB25 ≥ P164 - Trip Fault F_FaL 5 If TB25 ≥ P164 - Run Preset #7 6 If TB25 ≥ P164 - Run Preset Seg. #15			• Selects the reaction to a loss of the 4-20 mA signal at TB-25. • Signal is considered lost if it falls below the value set in P164 • Digital outputs can also indicate a loss of 4-20 mA signal; see P140, P142 • For P163 = 3 or 6, the accel/decel time is set in P781. **NOTE:** P163 has priority over TB-13 presets/auto references (P121-P124)

Code		Possible Settings				IMPORTANT
No.	Name	Default	Selection			
P 164	TB-25 (4-20mA) Analog Input Monitoring Level	2.0	0.0	{mA}	20.0	
P 165	Base Voltage		15	{V}	1000	Valid for V/Hz mode only. Set voltage for bus compensation in V/Hz mode
P 166	Carrier Frequency	See Notes	0 4 kHz 1 6 kHz 2 8 kHz 3 10 kHz			• As carrier frequency is increased, motor noise is decreased • Observe derating in section 2.3 • Automatic shift to 4 kHz at 120% load • NEMA 4X (IP65) Models: Default = 0 (4kHz) • NEMA 1 (IP31) Models: Default = 1 (6kHz)
P 167 (1)	Base Frequency	60.0	10.0	{Hz}	1500	 V0112
P 168	Fixed Boost		0.0	{%}	40.0	
			NOTE • P167 = rated motor frequency for standard applications • P165, P168 = default setting depends on drive rating			
P 169	Accel Boost	0.0	0.0	{%}	20.0	Accel Boost is only active during acceleration
P 170	Slip Compensation	0.0	0.0	{%}	40.0	Increase P170 until the motor speed no longer changes between no load and full load conditions.
P 171 (1)	Current Limit	Max I	30	{%}	Max I	• When the limit is reached, the drive displays CL (Current Limit), and either the acceleration time increases or the output frequency decreases. • Digital outputs can also indicate when the limit is reached; see P140, P142. • Refer to section 2.3 for the maximum output current Max I (%)
P 172	Current Limit Reduction	0	0 Current Limit Reduction Active - Normal response 1 Current Limit Reduction Active - Fast response 2 Current Limit Reduction Disabled - Normal response 3 Current Limit Reduction Disabled - Fast response			In field weakening, the Current Limit is inversely proportional to the speed.
P 173	Decel Override Time	2.0	0.0	{s}	60.0	Maximum time before drive trips into HF fault.
P 174	DC Brake Voltage	0.0	0.0	{%}	50.0	Setting is a percent of the nominal DC bus voltage.

(1) Any changes to this parameter will not take effect until the drive is stopped.

Code		Possible Settings				IMPORTANT
No.	Name	Default	Selection			
P175	DC Brake Time	0.0	0.0	{s}	999.9	
			NOTE: CONFIRM MOTOR SUITABILITY FOR USE WITH DC BRAKING DC Brake voltage (P174) is applied for the time specified by P175 with the following exceptions: • If P111=1, 3 and P175=999.9 the brake voltage will be applied continuously until a run or fault condition occurs. • If P110=2, 4…6 and P175=999.9, brake voltage will be applied for 15s • If P121…P124=18 and the corresponding TB-13 input is CLOSED, brake voltage will be applied until the TB-13 input is OPENED or a fault condition occurs.			
P176	Keypad Setpoint Single Press Increment	0.1	0.1		100.0	Used for run screen setpoint editing only. If P176 >0.1 then scrolling of keypad setpoint is disabled.
P177 (2)	Speed Units	0	0 Hz 1 RPM 2 % 3 /UNITS 4 NONE			Select the UNITS LED that will be illuminated when the drive is running in speed control mode. For this parameter to be used, P178 must be set to a value other than 0. IF P178 is set to 0, the Hz LED will be illuminated regardless of the value set in P177.
P178	Display Frequency Multiplier	0.00	0.00		650.00	• Allows frequency display to be scaled • P178 = 0.00: Scaling disabled • P178 > 0.00: Display = Actual Frequency X P178
			EXAMPLE If P178 = 29.17 and actual frequency = 60 Hz, then Drive displays 1750 (rpm)			
P179	Run Screen Display	0	0	{Parameter Number}	599	• 0 = Normal Run Screen, this display depends on mode of operation. Refer to section 4.2. • Other selections choose a diagnostic parameter to display (P501…P599). • Parameters P560 - P564 are selectable if the sequencer is enabled (P700 is not 0). P560-P564 are not visible until P700 is enabled.
P180	Oscillation Damping Control	0	0		80	0 = Damping disabled Compensation for resonances within drive
P181	Skip frequency 1	0.0	0.0	{Hz}	500	• Drive will not run in the defined skip range; used to skip over frequencies that cause mechanical vibration • P181 and P182 define the start of the skip ranges • P184 > 0 defines the bandwidth of both ranges.
P182	Skip frequency 2	0.0	0.0	{Hz}	500	
P184	Skip frequency bandwidth	0.0	0.0	{Hz}	10.0	
			NOTE Bandwidth (Hz) = f_s (Hz) + P184 (Hz) f_s = P181 or P182 EXAMPLE: P181 = 18 Hz and P184 = 4 Hz; skip range is from 18 to 22 Hz			
P185	Voltage Midpoint V/Hz characteristic	0	0.0	{V}	P165	Valid only when P300 = 0 or 2. Use with P187 to define midpoint on V/Hz curve.
P187 (2)	Frequency Midpoint V/Hz characteristic	0.0	0.0	{Hz}	P167	Valid only when P300 = 0 or 2. Use with P185 to define midpoint on V/Hz curve.
P189 (3)	Integrated Dynamic Brake		0 Disabled 1 Enabled			

(2) Parameter applicable to SMV models 15HP (11kW) and higher.

(3) Parameter applicable to SMV models 40HP (30kW) and higher.

Code		Possible Settings		IMPORTANT
No.	Name	Default	Selection	
P190	Motor Braking		0 Disabled	Flux brake OFF.
			1 Braking with BUS threshold	When drive is in deceleration and $V_{bus} > V_{decel\ on\ freeze}$ (114% of the rated V_{bus}), the flux brake will be turned ON.
			2 Braking always on with deceleration	As long as drive is in deceleration, the flux brake will be ON.
			3 Braking with bus regulator	When drive is in deceleration and $V_{bus} > V_{decel\ on\ freeze}$ (114% of the rated V_{bus}), the motor speed will be increased to reduce the bus voltage. Determined by the value in P191, the speed increment = slip speed * P191(%) / 37.
			4 Special	(Consult factory before using)
		⚠	**WARNING** Flux braking can cause heat in the motor. To avoid damage to the motor, use a PTC to protect the motor. If the flux brake is used too frequently, the drive will trip fault "F_PF".	
P191	Motor Brake Level	0	0 {%} 75 (flux braking disabled)	Active when P190 > 0 and drive is in deceleration mode. Use to reduce deceleration time on high inertia loads. **NOTE:** Over usage of P190 can cause frequent 'overload' trips "F.PF" Not active for P300 = 5 (Torque mode)
P192	Motor Braking Deceleration Reduction Level	0.0	0 P167 (base freq) Raising the value of P191 reduces the drive deceleration rate during flux braking.	Active when P190 > 0 and P192 > 0.0, Drive is in deceleration mode. Use to reduce deceleration time on high inertia loads. **NOTE**: Usage of P192 can cause the drive to decelerate faster than settings in P105/P127. Not active for P300 = 5 (Torque mode)
P194	Password	0	0000 9999	• Must enter password to access parameters • P194 = 0000: Disables password
P197	Clear Fault History	0	0 No Action	
			1 Clear Fault History	
P199	Program Selection		0 Operate from User settings	
			1 Operate from OEM settings	Refer to Notes 1, 2 and 3
			2 Reset to OEM default settings	Refer to Note 1
			3 Reset to 60 Hz default settings	• Refer to Note 4 • Parameters are reset to the defaults listed in this manual. • For P199=4, the following exceptions apply: - P103, P152, P161, P167 = 50.0 Hz - P165 = 400V (400/480V drives only) - P304 = 50 Hz - P305 = 1450 RPM - P107 = 0 (480 V drives only)
			4 Reset to 50 Hz default settings	
			5 Translate	Refer to Note 5
		⚠	**WARNING!** Modification of P199 can affect drive functionality! STOP and EXTERNAL FAULT circuitry may be disabled! Check P100 and P121...P124	
		ℹ	**NOTE 1** If the EPM does not contain valid OEM settings, a flashing CF will be displayed when P199 is set to 1 or 2. **NOTE 2** When P199 is set to 1, the drive operates from the OEM settings stored in the EPM Module and no other parameters can be changed (CE will be displayed if attempted). **NOTE 3** Auto Calibration is not possible when operating from OEM Settings. **NOTES 4 and 5 - on next page.**	

Code		Possible Settings		IMPORTANT
No.	Name	Default	Selection	
P199	Program Selection		**NOTE 4** Resetting to 50 and 60 Hz default settings will set the Assertion Level (P120) to "2" (High). P120 may need to be reset for the digital input devices being used. An F_AL fault may occur if P120 and the Assertion switch are not set identically. **NOTE 5** If an EPM that contains data from a previous compatible software version is installed: • The drive will operate according to the previous data, but parameters cannot be changed (cE will be displayed if attempted) • To update the EPM to the current software version, set P199 = 5. The parameters can now be changed but the EPM is incompatible with previous software revisions.	

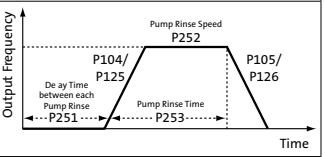
4.5.4 PID Parameters

Code		Possible Settings		IMPORTANT
No.	Name	Default	Selection	
P200	PID Mode	0	0 Disabled 1 Normal-acting 2 Reverse-acting 3 Normal-acting, Bi-directional 4 Reverse-acting, Bi-directional	• Normal-acting: As feedback increases, motor speed decreases • Reverse-acting: As feedback increases, motor speed increases • PID mode is disabled in Vector Torque mode (P300 = 5) • Selections 3, 4: If P112=1, PID controller output sets the speed, (range -max freq to +max freq)
			NOTE To activate PID mode, one of the TB-13 inputs (P121...P124) must be used to select the Auto Reference that matches the desired PID setpoint reference. If the selected PID setpoint reference uses the same analog signal as the PID feedback (P201), an F_IL fault will occur. **Example:** The desired PID setpoint reference is the keypad (▲ and ▼). Set TB-13x = 6 (Auto Reference: Keypad): • TB-13x = closed: PID mode is active • TB-13x = open: PID mode is disabled and the drive speed will be controlled by the reference selected in P101.	
P201	PID Feedback Source	0	0 4-20 mA (TB-25) 1 0-10 VDC (TB-5) 2 Drive Load (P507) 3 Feedback from Network	Must be set to match the PID feedback signal
P202	PID Decimal Point	1	0 PID Display = XXXX 1 PID Display = XXX.X 2 PID Display = XX.XX 3 PID Display = X.XXX 4 PID Display = .XXXX	Applies to P204, P205, P214, P215, P231...P233, P242, P522, P523
P203 (2)	PID Units	0	0 % 1 /UNITS 2 AMPS 3 NONE	Select the UNITS LED that will be illuminated when the drive is running in PID control mode
P204	Feedback at Minimum Signal	0.0	-99.9 3100.0	Set to match the range of the feedback signal being used
P205	Feedback at Maximum Signal	100.0	-99.9 3100.0	**Example:** Feedback signal is 0 - 300 PSI; P204 = 0.0, P205 = 300.0

(2) Parameter applicable to SMV models 15HP (11kW) and higher.

Code		Possible Settings				IMPORTANT
No.	Name	Default	Selection			
P207	Proportional Gain	5.0	0.0	{%}	1000.0	Used to tune the PID loop: • Increase P207 until system becomes unstable, then decrease P207 by 10-15% • Next, increase P208 until feedback matches setpoint • If required, increase P209 to compensate for sudden changes in feedback
P208	Integral Gain	0.0	0.0	{s}	20.0	
P209	Derivative Gain	0.0	0.0	{s}	20.0	
			NOTE • Derivative Gain is very sensitive to noise on the feedback signal. Use with care. • Derivative Gain is not normally required in pump and fan applications			
P210	PID Setpoint Ramp	20.0	0.0	{s}	100.0	• time of setpoint change from P204 to P205 or vice versa. • Used to smooth the transition from one PID setpoint to another, such as when using the Preset PID Setpoints (P231...P233)
P214	Minimum Alarm	0.0	P204		P205	Use with P140, P142 = 18...23
P215	Maximum Alarm	0.0	P204		P205	
P231	Preset PID Setpoint #1	0.0	P204		P205	TB-13A activated; P121 = 3 and P200 = 1 or 2
P232	Preset PID Setpoint #2	0.0	P204		P205	TB-13B activated; P122 = 3 and P200 = 1 or 2
P233	Preset PID Setpoint #3	0.0	P204		P205	TB-13C activated; P123 = 3 and P200 = 1 or 2
P234(2)	Preset PID Setpoint #4	0.0	P204		P205	TB-13D activated; P124 = 3 and P200 = 1 or 2
P240	Sleep Threshold	0.0	0.0	{Hz}	500.0	• If drive speed < P240 for longer than P241, output frequency = 0.0 Hz; drive display = SLP • P240 = 0.0: Sleep mode is disabled. • P200 = 0…2: Drive will start again when speed command is above P240 • P242 > 0.0: Drive will restart when the PID feedback differs from the setpoint by more than the value of P242 **or** when the PID loop requires a speed above P240.
P241	Sleep Delay	30.0	0.0	{s}	300.0	
P242	Sleep Bandwidth	0.0	0.0 Where: B_{max} = |(P205 - P204)|		B_{max}	
P243	Feedback Sleep Entry Threshold	0.0	P204		P205	Active only when P244 = 1 or 2
P244	Sleep Entry Mode	0	0 Enter SLEEP if Drive Speed <P240			For time longer than P241
			1 Enter SLEEP if Feedback >P243			For time longer than P241 or same as Sel 0
			2 Enter SLEEP if Feedback <P243			For time longer than P241 or same as Sel 0
P245	Sleep Entry Stop Type	0	0 Coast to Stop			
			1 Ramp to Stop			
			2 Stop with P111 settings			
P246	Feedback Recovery from Sleep Threshold	0.0	P204		P205	Active only when P247 = 1 or 2
P247	Sleep Recovery Mode	0	0 Recovery if Speed Setpoint > P240 or if PID feedback differs from setpoint by more than P242			
			1 Recovery only if Feedback < P246			
			2 Recovery only if Feedback > P246			

(2) Parameter applicable to SMV models 15HP (11kW) and higher.

Code		Possible Settings				IMPORTANT
No.	Name	Default	Selection			
P250	Auto Rinse in Sleep Mode	0	0 Disabled 1 Enabled			Activated in sleep mode only. Sleep Recovery cancels Auto Rinse
P251	Time Delay between Auto Rinses	30.0	0.0	{min}	6553.5	Time delay reset by re/entering sleep mode
P252	Auto Rinse Speed	0.0	-500.0	{Hz}	500.0	If P112 = 1, negative sign = reverse direction
P253	Auto Rinse Time	0.0	0.0	{sec}	6553.5	Does not include time to decel back to speed
			Auto Pump Rinse Setup: P250=1 (Enabled) P251=# minutes between each PumpRinse P252=Hz speed of Pump Rinse P253=# seconds Pump Rinse duration			
P280	Current Level: Flying Restart Type 2	70.0	0.0	{%}	P171	Maximum current during Type 2 flying restart operation
P281	Decel Time: Flying Restart Type 2	3.0	0.0	{sec}	3600.0	Deceleration rate used during Type 2 flying restart operation

4.5.5 Vector Parameters

Code		Possible Settings				IMPORTANT
No.	Name	Default	Selection			
P300 (1)	Drive Mode	0	0 Constant V/Hz			Constant torque V/Hz control for general applications
			1 Variable V/Hz			Variable torque V/Hz control for centrifugal pump and fan applications
			2 Enhanced Constant V/Hz 3 Enhanced Variable V/Hz			For single or multiple motor applications that require better performance than settings 0 or 1, but cannot use Vector mode, due to: • Missing required motor data • Vector mode causing unstable motor operation
			4 Vector Speed			For single-motor applications requiring higher starting torque and speed regulation
			5 Vector Torque			For single-motor applications requiring torque control independent of speed
			NOTE To configure the drive for either Vector mode or Enhanced V/Hz mode: • P300 = 4, 5: - Set P302...P306 according to motor nameplate - Set P399 = 1 or 2 (if option 1 failed or in case of non-standard motor) - Make sure motor is cold (20° - 25° C) and apply a Start command - Display will indicate CAL for about 40 seconds - Once the calibration is complete, the display will indicate StoP; apply another Start command to actually start the motor - If an attempt is made to start the drive in Vector or Enhanced V/Hz mode before performing the Motor Calibration, the drive will display F_n Id and will not operate • P300 = 2, 3: Same as above but only need to set P302…P304			
P302 (1)	Motor Rated Voltage		0	{V}	600	• Default setting = drive rating • Set to motor nameplate data
P303 (1)	Motor Rated Current		0.1	{A}	500.0	

(1) Any changes to this parameter will not take effect until the drive is stopped.

Code		Possible Settings				IMPORTANT
No.	Name	Default	Selection			
P304 (1)	Motor Rated Frequency	60	0	{Hz}	1000	Set to motor nameplate data
P305 (1)	Motor Rated Speed	1750	300	{RPM}	65000	
P306 (1)	Motor Cosine Phi	0.80	0.40		0.99	
		i	**NOTE** If motor cosine phi is not known, use one of the following formulas: cos phi = motor Watts / (motor efficiency X P302 X P303 X 1.732) cos phi = cos [sin $^{-1}$ (magnetizing current / motor current)]			
P310 (1)	Motor Stator Resistance		0.00	{Ω}	64.00	• P310, 311 default setting depends on drive rating • Will be automatically programmed by P399 • Changing these settings can adversely affect performance. Contact factory technical support prior to changing
P311 (1)	Motor Stator Inductance		0.0	{mH}	2000	
P315	Dead Time Compensation Factor	0.0	-50.0	{%}	+50.0	• Adjust dead time correction from internal default • Takes effect when P399 = 3.
P330	Torque Limit	100	0	{%}	400	When P300 = 5, sets the maximum output torque.
P331	Preset Torque Setpoint #1	100	0	{%}	400	TB-13A activated; P121 = 3 and P300 = 5
P332	Preset Torque Setpoint #2	100	0	{%}	400	TB-13B activated; P122 = 3 and P300 = 5
P333	Preset Torque Setpoint #3	100	0	{%}	400	TB-13C activated; P123 = 3 and P300 = 5
P334 (2)	Preset Torque Setpoint #4	100	0	{%}	400	TB-13D activated; P124 = 3 and P300 = 5
P340 (1)	Current Loop P Gain	0.25	0.00		16.0	Changing these settings can adversely affect performance. Contact factory technical support prior to changing.
P341 (1)	Current Loop I Gain	65	12	{ms}	9990	
P342 (1)	Speed Loop Adjust	0.0	0.0	{%}	20.0	
P343	Slip Compensation Response Filter	99	90	{ms}	9999	Low pass filter time constant for varying the slip compensation response to changes in the motor current.
P399	Motor Auto-calibration	0	0 Calibration Not Done 1 Standard Calibration Enabled 2 Advanced Calibration Enabled 3 Bypass Calibration, enable operation in vector mode w/o Auto Calibration 4 Standard Calibration Complete 5 Advanced Calibration Complete			• If P300 = 4 or 5, motor calibration must be performed if P399 is not set to 3 (bypass calibration). • If P300=2 or 3, motor calibration is recommended. • Use option 2 if option 1 failed or in case of non-standard motors • An alternating CAL / Err will occur if: - attempt motor calibration with P300 = 0 or 1 - motor calibration is attempted before programming motor data
		i	**NOTE:** To run the Auto Calibration: – Set P302...P306 according to motor nameplate – Set P399 = 1 or 2 (if option 1 failed or in case of non-standard motor) – Make sure motor is cold (20° - 25° C) – Apply a Start command – Display will indicate CAL for about 40 seconds – Once the calibration is complete, the display will indicate StoP; apply another Start command to actually start the motor – Parameter P399 will now be set to 4 or 5.			

(1) Any changes to this parameter will not take effect until the drive is stopped.

(2) Parameter applicable to SMV models 15HP (11kW) and higher.

4.5.6 Network Parameters

Code		Possible Settings		IMPORTANT
No.	Name	Default	Selection	
P400	Network Protocol		0 Not Active	This parameter setting is based upon the network or I/O module that is installed.
			1 Remote Keypad	
			2 Modbus RTU	
			3 CANopen	
			4 DeviceNet	
			5 Ethernet	
			6 Profibus	
			7 Lecom-B	
			8 I/O Module	
P401	Module Type Installed	0	0 No Module Installed	Module type format: 0xAABC; Drive Display: AA.B.C AA = Module Type B = Major revision C = minor revision
			1 Basic I/O (0x0100, 1.0.0)	
			2 RS485/Rem. Keypad (0x0200, 2.0.0)	
			3 CANopen (0x0300, 3.0.0)	
			11 PROFIBUS (0x1100, 11.0.0)	
			12 Ethernet (0x1200, 12.0.0)	
P402	Module Status	0	0 Not Initialized	
			1 Initialization: Module to EPM	
			2 Initialization: EPM to Module	
			3 Online	
			4 Failed Initialization Error	
			5 Time-out Error	
			6 Initialization Failed	Module type mismatch P401
			7 Initialization Error	Protocol selection mismatch P400
P403	Module Reset	0	0 No Action	Returns module parameters 401…499 to the default values shown in the manual
			1 Reset parameters to default values	
P404	Module Timeout Action	3	0 No Fault	Action to be taken in the event of a Module/ Drive Time-out. Time is fixed at 200ms STOP is by the method selected in P111.
			1 STOP (see P111)	
			2 Quick Stop	
			3 Fault (F_ntF)	
P405	Current Network Fault		0 No Fault	
			1 F.nF1	NetIdle Mode
			2 F.nF2	Loss of Ethernet I/O connection
			3 F.nF3	Network Fault
			4 F.nF4	Explicit Message Timeout
			5 F.nF5	Overall Network Timeout
			6 F.nF6	Overall Explicit Timeout
			7 F.nF7	Overall I/O Message Timeout
P406	Proprietary			Manufacturer specific
P407 … P499		Module Specific Parameters		Refer to the Communications Reference Guide specific to the network or I/O module installed.

4.5.7 Diagnostic Parameters

Code		Display Range (READ ONLY)			IMPORTANT
No.	Name				
P500	Fault History				• Displays the last 8 faults • Format: n.xxx where: n = 1..8, 1 is the newest fault; xxx = fault message (w/o the **F.**) • Refer to section 5.3
P501	Software Version				Format: x.yz
P502	Drive ID				A flashing display indicates that the Drive ID stored in the EPM does not match the drive model it is plugged into.
P503	Internal Code				Alternating Display: xxx-; -yy
P505	DC Bus Voltage	0	{VDC}	1500	
P506	Motor Voltage	0	{VAC}	1000	
P507	Load	0	{%}	255	Motor load as % of drive's output current rating. Refer to section 2.3.
P508	Motor Current	0.0	{A}	1000	Actual motor current
P509	Torque	0	{%}	500	Torque as % of motor rated torque (vector mode only)
P510	Output Power kW	0.00	{kW}	650.0	
P511	Total kWh	0.0	{kWh}	9999999	Alternating display: xxx-; yyyy when value exceeds 9999
P512	Heatsink Temp	0	{°C}	150	Heatsink temperature
P520	0-10 VDC Input	0.0	{VDC}	10.0	Actual value of signal at TB-5 (See P162)
P521	4-20 mA Input	0.0	{mA}	20.0	Actual value of signal at TB-25 (See P162)
P522	TB-5 Feedback	P204		P205	TB-5 signal value scaled to PID feedback units (See P162)
P523	TB-25 Feedback	P204		P205	TB-25 signal value scaled to PID feedback units (See P162)
P524	Network Feedback	P204		P205	Network signal value scaled to PID feedback units
P525	Analog Output	0	{VDC}	10.0	Refer to P150…P155
P527	Actual Output Frequency	0	{Hz}	500.0	
P528	Network Speed Command	0	{Hz}	500.0	Command speed if (Auto: Network) is selected as the speed source
P530	Terminal and Protection Status				Indicates terminal status using segments of the LED display. (Refer to section 4.5.7.1)
P531	Keypad Status				Indicates keypad button status using segments of the LED display. (Refer to section 4.5.7.2)
P540	Total Run Time	0	{h}	9999999	Alternating display: xxx-; yyyy when value exceeds 9999
P541	Total Power On Time	0	{h}	9999999	
P550	Fault History	1		8	• Displays the last 8 faults • Format: n.xxx where: n = 1..8, 1 is the newest fault; xxx = fault message (w/o the **F.**) • Refer to section 5.3
P551	Fault History Time	0	{h}	999999	Display: "n.hh-" "hhhh" "mm.ss" = fault #, hours, seconds The "hhhh" screen is displayed after hours exceed 999.
P552	Fault History Counter	0		255	Number of sequential occurrences of a fault. For example: 3 external faults occur over a period of time with no other errors occurring. Then P552 will indicate 3, P550 will indicate the error EF and P551 will indicate the time of the first fault occurrence.

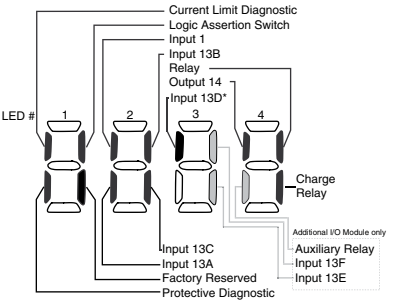
Code		Display Range (READ ONLY)			IMPORTANT
No.	Name				
P560	Sequencer: Currently Active Segment	0		17	
P561	Sequencer: Time since Start of Active Segment	0.0 0	{P708} {P708}	6553.5 65535	Unit depends on P708 (0.1sec, sec or minutes)
P562	Sequencer: Time Remaining in Active Segment	0.0 0	{P708} {P708}	6553.5 65535	Unit depends on P708 (0.1sec, sec or minutes)
P563	Sequencer: Number of cycles since start	0		65535	
P564	Sequencer: Number of cycles remaining	0		65535	
		NOTE: Parameters P560-P564 are visible only when P700 > 0 (i.e. the sequencer is enabled)			

4.5.7.1 Terminal & Protection Status Display

Parameter P530 allows monitoring of the control terminal points and common drive conditions:

An illuminated LED segment indicates:

- the protective circuit is active (LED 1)
- the Logic Assertion Switch is set to High (+)
- input terminal is asserted (LED 2)
- output terminal is energized (LED 4)
- the Charge Relay is not a terminal, this segment will be illuminated when the Charge Relay is energized (LED 4).



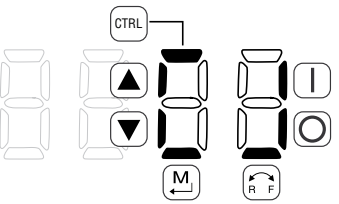
* Input 13D available on 15-60HP (11-45kW) models only

4.5.7.2 Keypad Status Display

Parameter P531 allows monitoring of the keypad pushbuttons:

An illuminated LED segment indicates when the button is depressed.

LED 1 and LED 2 are used to indicate pushbutton presses on a remote keypad that is attached to the drive. LED 3 and LED 4 indicate button presses on the local drive keypad.



4.5.8 Onboard Communications Parameters 15-60HP (11-45kW)

The P6xx Onboard Communication parameters are applicable to the 15HP (11kW) and higher models only.

Code		Possible Settings		IMPORTANT
No.	Name	Default	Selection	
P600	Network Enable	0	0 Disabled 1 Remote Keypad 2 Modbus 7 Lecom	This parameter enables the onboard network communications.
			NOTE: Onboard Communications will be disabled if: - P600 = 0, or - P600 = 1 and P400 = 1, or - P600 = 2 and P400 = 2, 3, 4, 5, 6 or 7 - P600 = 7 and P400 = 2, 3, 4, 5, 6 or 7	If the onboard communications are disabled, the user will not have access to any of the other P6xx parameters.
P610	Network Address	1	1 - 247	Modbus
		1	1 - 99	Lecom
P611	Network Baud Rate	2	0 2400 bps 2 9600 bps 1 4800 bps 3 19200 bps	Modbus
		0	0 9600 bps 1 4800 bps 2 2400 bps 3 1200 bps 4 19200 bps	Lecom
P612	Network Data Format	0	0 8, N, 2 1 8, N, 1 2 8, E, 1 3 8, O, 1	Modbus Only
P620	Network Control Level	0	0 Monitor Only 1 Parameter Programming 2 Programming and Setpoint Control 3 Full Control	Lecom Only
P624	Network Powerup Start Status	0	0 Quick Stop 1 Controller Inhibit	Lecom Only
P625	Network Timeout	10.0	0.0 - 300.0 seconds	Modbus
		50	0 - 65000 milliseconds	Lecom
P626	Network Timeout Action	4	0 No action 1 Stop (P111) 2 Quick Stop 3 Controller Inhibit 4 Trip Fault, F.nF1	Modbus
		0	0 No action 1 Controller Inhibit 2 Quick Stop 3 Trip Fault, F.nF1	Lecom
P627	Network Messages Received		Read-Only: 0 - 9999	Valid network messages received
			NOTE: When the number of messages exceeds 9999, the counter resets and resumes counting from 0.	

4.5.9 Sequencer Parameters

The P700 Sequencer parameters are listed herein. Refer to section 4.5.7 for P56x Sequencer Diagnostic Parameters. The sequencer function consists of 16 step segments, each individual step segment can have its own ramp time, time spent in individual segment and output frequency entered. The sequencer has 3 different modes to control how the drive moves through each individual step segment: Timer Transition, Step Sequence or Timer and Step Sequence.

P700= 1 (Timer Transition)

Starting at the segment number entered in the "Start Segment" parameter, the drive will automatically move through each of the segments. The time spent in each segment is determined by the values set in the individual "Time in Current Step" parameters.

P700= 2 (Step Sequence)

Starting at the segment number entered in the "Start Segment" parameter the sequencer will only move to the next segment when a rising edge is applied to the highest priority digital input which is programmed to "Step Sequence" selection "24".

P700= 3 (Timer Transition or Step Sequence)

Starting at the segment number entered in the "Start Segment" parameter, the drive will automatically move through each of the segments. The time spent in each segment is determined by the values set in the individual "Time in Current Step" parameters, however if a rising edge is applied to the highest priority digital input which is programmed to "Step Sequence" selection "24" it will force the sequencer to step into the next segment.

NOTE: A value of "0" in the "Time in current step" parameter (ex: P712), will result in the segment being skipped.

Code		Possible Settings		IMPORTANT
No.	Name	Default	Selection	
P700	Sequencer Mode	0	0 Disabled 1 Enabled: transition on timer only 2 Enabled: transition on rising edge (P121, 122, 123 = 25 step sequence) 3 Enabled: transition on timer or rising edge	If P700 = 0 and no reference (P121, P101) points to any of the sequence segments, then P701-P799 will not be displayed on the local keypad.
P701	Sequencer: TB13A Trigger Segment	1	1 - 16 TB13A = lowest priority	Asserting TB13A with selection #24 (Start Sequence), starts the sequence operation from the segment specified in this parameter.
P702	Sequencer: TB13B Trigger Segment	1	1 - 16 TB13B: higher priority than TB13A	Asserting TB13B with selection #24 (Start Sequence), starts the sequence operation from the segment specified in this parameter.
P703	Sequencer: TB13C Trigger Segment	1	1 - 16 TB13C: higher priority thanTB13B, A	Asserting TB13C with selection #24 (Start Sequence), starts the sequence operation from the segment specified in this parameter.
P704(2)	Sequencer: TB13D Trigger Segment	1	1 - 16 TB13D: higher priority than TB13C, B, A	Asserting TB13D with selection #24 (Start Sequence), starts the sequence operation from the segment specified in this parameter.
P706	Sequencer: Action after Stop/Start transition or Fault Restart	0	0 Restart at beginning of sequence 1 Restart at beginning of current seg 2 Start at beginning of prior segment 3 Start at beginning of next segment	Pointed by TB13x
P707	Sequencer: Number of cycles	1	1 65535	1 = single scan; 65535 = continuous loop

(2) Parameter applicable to SMV models 15HP (11kW) and higher.

<table>
<tr><th colspan="2">Code</th><th colspan="4">Possible Settings</th><th rowspan="2">IMPORTANT</th></tr>
<tr><th>No.</th><th>Name</th><th>Default</th><th colspan="3">Selection</th></tr>
<tr><td rowspan="2">P708</td><td rowspan="2">Sequencer: Time units/scaling</td><td>0</td><td colspan="3">0 0.1 {sec} 6553.5
1 1 {sec} 65535
2 1 {min} 65535</td><td>Setup units/scaling for all sequencer time related parameters</td></tr>
<tr><td></td><td colspan="4">NOTE:
P708 rescales the following sequencer related parameters:
- Segment Times in current step: P712, P717, P722, P727, P732, P737, P742, P747, P752, P757, P762, P767, P772, P777, P782, P787, P792
- Sequence diagnostic/status: P561, P562</td></tr>
<tr><td></td><td colspan="6">Segment #1</td></tr>
<tr><td>P710</td><td>Segment #1 Frequency Setpoint</td><td>0.0</td><td>-500.0</td><td>{Hz}</td><td>500.0</td><td>If P112 = 1, negative sign forces reverse direction</td></tr>
<tr><td>P711</td><td>Segment #1 Accel/Decel Time</td><td>20.0</td><td>0.0</td><td>{sec}</td><td>3600.0</td><td></td></tr>
<tr><td>P712</td><td>Segment #1 Time in current step</td><td>0.0
0</td><td>0.0
0</td><td>{P708}
{P708}</td><td>6553.5
65535</td><td>Scaling/units depend on P708
Skip segment if time = 0</td></tr>
<tr><td>P713</td><td>Segment #1 Digital Output State</td><td>0</td><td colspan="3"><table><tr><th>Value set in P713</th><th>0</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th></tr><tr><td>Relay (Bit 0)</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td></tr><tr><td>TB14 (Bit 1)</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td></tr><tr><td>I/O option Relay (Bit 2)</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td></tr></table>NOTE: P441 is the Relay Output (TB-19, 20, 21) of the optional Digital I/O module (ESVZAL0, ESVZAL1).</td><td>bit = 0: OFF (De-energized)
bit = 1: ON (Energized)
The corresponding digital output/relay must be set to accept data from the sequencer: P140, P142, P441 = 27</td></tr>
<tr><td>P714</td><td>Segment #1 TB30 Analog Output Value</td><td>0.00</td><td>0.00</td><td>{VDC}</td><td>10.00</td><td>TB30 configuration parameter must be set to accept this value: P150 = 10</td></tr>
<tr><td></td><td colspan="6">Segment #2</td></tr>
<tr><td>P715</td><td>Segment #2 Frequency Setpoint</td><td>0.0</td><td>-500.0</td><td>{Hz}</td><td>500.0</td><td>If P112 = 1, negative sign forces reverse direction</td></tr>
<tr><td>P716</td><td>Segment #2 Accel/Decel Time</td><td>20.0</td><td>0.0</td><td>{sec}</td><td>3600.0</td><td></td></tr>
<tr><td>P717</td><td>Segment #2 Time in current step</td><td>0.0
0</td><td>0.0
0</td><td>{P708}
{P708}</td><td>6553.5
65535</td><td>Scaling/units depend on P708
Skip segment if time = 0</td></tr>
<tr><td>P718</td><td>Segment #2 Digital Output State</td><td>0</td><td colspan="3"><table><tr><th>Value set in P718</th><th>0</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th></tr><tr><td>Relay (Bit 0)</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td></tr><tr><td>TB14 (Bit 1)</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td></tr><tr><td>I/O option Relay (Bit 2)</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td></tr></table>NOTE: P441 is the Relay Output (TB-19, 20, 21) of the optional Digital I/O module (ESVZAL0, ESVZAL1).</td><td>bit = 0: OFF (De-energized)
bit = 1: ON (Energized)
The corresponding digital output/relay must be set to accept data from the sequencer: P140, P142, P441 = 27</td></tr>
<tr><td>P719</td><td>Segment #2 TB30 Analog Output Value</td><td>0.00</td><td>0.00</td><td>{VDC}</td><td>10.00</td><td>TB30 configuration parameter must be set to accept this value: P150 = 10</td></tr>
</table>

Code		Possible Settings				IMPORTANT
No.	Name	Default	Selection			
	Segment #3					
P720	Segment #3 Frequency Setpoint	0.0	-500.0	{Hz}	500.0	If P112 = 1, negative sign forces reverse direction
P721	Segment #3 Accel/Decel Time	20.0	0.0	{sec}	3600.0	
P722	Segment #3 Time in current step	0.0 0	0.0 0	{P708} {P708}	6553.5 65535	Scaling/units depend on P708 Skip segment if time = 0
P723	Segment #3 Digital Output State	0	**Value set in P723** 0 1 2 3 4 5 6 7 Relay (Bit 0) 0 1 0 1 0 1 0 1 TB14 (Bit 1) 0 0 1 1 0 0 1 1 I/O option Relay (Bit 2) 0 0 0 0 1 1 1 1 NOTE: P441 is the Relay Output (TB-19, 20, 21) of the optional Digital I/O module (ESVZAL0, ESVZAL1).			bit = 0: OFF (De-energized) bit = 1: ON (Energized) The corresponding digital output/relay must be set to accept data from the sequencer: P140, P142, P441 = 27
P724	Segment #3 TB30 Analog Output Value	0.00	0.00	{VDC}	10.00	TB30 configuration parameter must be set to accept this value: P150 = 10
	Segment #4					
P725	Segment #4 Frequency Setpoint	0.0	-500.0	{Hz}	500.0	If P112 = 1, negative sign forces reverse direction
P726	Segment #4 Accel/Decel Time	20.0	0.0	{sec}	3600.0	
P727	Segment #4 Time in current step	0.0 0	0.0 0	{P708} {P708}	6553.5 65535	Scaling/units depend on P708 Skip segment if time = 0
P728	Segment #4 Digital Output State	0	**Value set in P728** 0 1 2 3 4 5 6 7 Relay (Bit 0) 0 1 0 1 0 1 0 1 TB14 (Bit 1) 0 0 1 1 0 0 1 1 I/O option Relay (Bit 2) 0 0 0 0 1 1 1 1 NOTE: P441 is the Relay Output (TB-19, 20, 21) of the optional Digital I/O module (ESVZAL0, ESVZAL1).			bit = 0: OFF (De-energized) bit = 1: ON (Energized) The corresponding digital output/relay must be set to accept data from the sequencer: P140, P142, P441 = 27
P729	Segment #4 TB30 Analog Output Value	0.00	0.00	{VDC}	10.00	TB30 configuration parameter must be set to accept this value: P150 = 10
	Segment #5					
P730	Segment #5 Frequency Setpoint	0.0	-500.0	{Hz}	500.0	If P112 = 1, negative sign forces reverse direction
P731	Segment #5 Accel/Decel Time	20.0	0.0	{sec}	3600.0	
P732	Segment #5 Time in current step	0.0 0	0.0 0	{P708} {P708}	6553.5 65535	Scaling/units depend on P708 Skip segment if time = 0
P733	Segment #5 Digital Output State	0	**Value set in P733** 0 1 2 3 4 5 6 7 Relay (Bit 0) 0 1 0 1 0 1 0 1 TB14 (Bit 1) 0 0 1 1 0 0 1 1 I/O option Relay (Bit 2) 0 0 0 0 1 1 1 1 NOTE: P441 is the Relay Output (TB-19, 20, 21) of the optional Digital I/O module (ESVZAL0, ESVZAL1).			bit = 0: OFF (De-energized) bit = 1: ON (Energized) The corresponding digital output/relay must be set to accept data from the sequencer: P140, P142, P441 = 27
P734	Segment #5 TB30 Analog Output Value	0.00	0.00	{VDC}	10.00	TB30 configuration parameter must be set to accept this value: P150 = 10

Code		Possible Settings				IMPORTANT
No.	Name	Default	Selection			
	Segment #6					
P735	Segment #6 Frequency Setpoint	0.0	-500.0	{Hz}	500.0	If P112 = 1, negative sign forces reverse direction
P736	Segment #6 Accel/Decel Time	20.0	0.0	{sec}	3600.0	
P737	Segment #6 Time in current step	0.0 0	0.0 0	{P708} {P708}	6553.5 65535	Scaling/units depend on P708 Skip segment if time = 0
P738	Segment #6 Digital Output State	0	**Value set in P738** 0 1 2 3 4 5 6 7 Relay (Bit 0) 0 1 0 1 0 1 0 1 TB14 (Bit 1) 0 0 1 1 0 0 1 1 I/O option Relay (Bit 2) 0 0 0 0 1 1 1 1 NOTE: P441 is the Relay Output (TB-19, 20, 21) of the optional Digital I/O module (ESVZAL0, ESVZAL1).			bit = 0: OFF (De-energized) bit = 1: ON (Energized) The corresponding digital output/relay must be set to accept data from the sequencer: P140, P142, P441 = 27
P739	Segment #6 TB30 Analog Output Value	0.00	0.00	{VDC}	10.00	TB30 configuration parameter must be set to accept this value: P150 = 10
	Segment #7					
P740	Segment #7 Frequency Setpoint	0.0	-500.0	{Hz}	500.0	If P112 = 1, negative sign forces reverse direction
P741	Segment #7 Accel/Decel Time	20.0	0.0	{sec}	3600.0	
P742	Segment #7 Time in current step	0.0 0	0.0 0	{P708} {P708}	6553.5 65535	Scaling/units depend on P708 Skip segment if time = 0
P743	Segment #7 Digital Output State	0	**Value set in P743** 0 1 2 3 4 5 6 7 Relay (Bit 0) 0 1 0 1 0 1 0 1 TB14 (Bit 1) 0 0 1 1 0 0 1 1 I/O option Relay (Bit 2) 0 0 0 0 1 1 1 1 NOTE: P441 is the Relay Output (TB-19, 20, 21) of the optional Digital I/O module (ESVZAL0, ESVZAL1).			bit = 0: OFF (De-energized) bit = 1: ON (Energized) The corresponding digital output/relay must be set to accept data from the sequencer: P140, P142, P441 = 27
P744	Segment #7 TB30 Analog Output Value	0.00	0.00	{VDC}	10.00	TB30 configuration parameter must be set to accept this value: P150 = 10
	Segment #8					
P745	Segment #8 Frequency Setpoint	0.0	-500.0	{Hz}	500.0	If P112 = 1, negative sign forces reverse direction
P746	Segment #8 Accel/Decel Time	20.0	0.0	{sec}	3600.0	
P747	Segment #8 Time in current step	0.0 0	0.0 0	{P708} {P708}	6553.5 65535	Scaling/units depend on P708 Skip segment if time = 0
P748	Segment #8 Digital Output State	0	**Value set in P748** 0 1 2 3 4 5 6 7 Relay (Bit 0) 0 1 0 1 0 1 0 1 TB14 (Bit 1) 0 0 1 1 0 0 1 1 I/O option Relay (Bit 2) 0 0 0 0 1 1 1 1 NOTE: P441 is the Relay Output (TB-19, 20, 21) of the optional Digital I/O module (ESVZAL0, ESVZAL1).			bit = 0: OFF (De-energized) bit = 1: ON (Energized) The corresponding digital output/relay must be set to accept data from the sequencer: P140, P142, P441 = 27
P749	Segment #8 TB30 Analog Output Value	0.00	0.00	{VDC}	10.00	TB30 configuration parameter must be set to accept this value: P150 = 10

Code		Possible Settings				IMPORTANT
No.	Name	Default	Selection			
	Segment #9					
P750	Segment #9 Frequency Setpoint	0.0	-500.0	{Hz}	500.0	If P112 = 1, negative sign forces reverse direction
P751	Segment #9 Accel/Decel Time	20.0	0.0	{sec}	3600.0	
P752	Segment #9 Time in current step	0.0 0	0.0 0	{P708} {P708}	6553.5 65535	Scaling/units depend on P708 Skip segment if time = 0
P753	Segment #9 Digital Output State	0	**Value set in P753** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** Relay (Bit 0) | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 TB14 (Bit 1) | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 I/O option Relay (Bit 2) | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 NOTE: P441 is the Relay Output (TB-19, 20, 21) of the optional Digital I/O module (ESVZAL0, ESVZAL1).			bit = 0: OFF (De-energized) bit = 1: ON (Energized) The corresponding digital output/relay must be set to accept data from the sequencer: P140, P142, P441 = 27
P754	Segment #9 TB30 Analog Output Value	0.00	0.00	{VDC}	10.00	TB30 configuration parameter must be set to accept this value: P150 = 10
	Segment #10					
P755	Segment #10 Frequency Setpoint	0.0	-500.0	{Hz}	500.0	If P112 = 1, negative sign forces reverse direction
P756	Segment #10 Accel/Decel Time	20.0	0.0	{sec}	3600.0	
P757	Segment #10 Time in current step	0.0 0	0.0 0	{P708} {P708}	6553.5 65535	Scaling/units depend on P708 Skip segment if time = 0
P758	Segment #10 Digital Output State	0	**Value set in P758** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** Relay (Bit 0) | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 TB14 (Bit 1) | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 I/O option Relay (Bit 2) | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 NOTE: P441 is the Relay Output (TB-19, 20, 21) of the optional Digital I/O module (ESVZAL0, ESVZAL1).			bit = 0: OFF (De-energized) bit = 1: ON (Energized) The corresponding digital output/relay must be set to accept data from the sequencer: P140, P142, P441 = 27
P759	Segment #10 TB30 Analog Output Value	0.00	0.00	{VDC}	10.00	TB30 configuration parameter must be set to accept this value: P150 = 10
	Segment #11					
P760	Segment #11 Frequency Setpoint	0.0	-500.0	{Hz}	500.0	If P112 = 1, negative sign forces reverse direction
P761	Segment #11 Accel/Decel Time	20.0	0.0	{sec}	3600.0	
P762	Segment #11 Time in current step	0.0 0	0.0 0	{P708} {P708}	6553.5 65535	Scaling/units depend on P708 Skip segment if time = 0
P763	Segment #11 Digital Output State	0	**Value set in P763** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** Relay (Bit 0) | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 TB14 (Bit 1) | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 I/O option Relay (Bit 2) | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 NOTE: P441 is the Relay Output (TB-19, 20, 21) of the optional Digital I/O module (ESVZAL0, ESVZAL1).			bit = 0: OFF (De-energized) bit = 1: ON (Energized) The corresponding digital output/relay must be set to accept data from the sequencer: P140, P142, P441 = 27
P764	Segment #11 TB30 Analog Output Value	0.00	0.00	{VDC}	10.00	TB30 configuration parameter must be set to accept this value: P150 = 10

Code		Possible Settings				IMPORTANT
No.	Name	Default	Selection			
	Segment #12					
P765	Segment #12 Frequency Setpoint	0.0	-500.0	{Hz}	500.0	If P112 = 1, negative sign forces reverse direction
P766	Segment #12 Accel/Decel Time	20.0	0.0	{sec}	3600.0	
P767	Segment #12 Time in current step	0.0 0	0.0 0	{P708} {P708}	6553.5 65535	Scaling/units depend on P708 Skip segment if time = 0
P768	Segment #12 Digital Output State	0	**Value set in P768** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** Relay (Bit 0) | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 TB14 (Bit 1) | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 I/O option Relay (Bit 2) | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 NOTE: P441 is the Relay Output (TB-19, 20, 21) of the optional Digital I/O module (ESVZAL0, ESVZAL1).			bit = 0: OFF (De-energized) bit = 1: ON (Energized) The corresponding digital output/relay must be set to accept data from the sequencer: P140, P142, P441 = 27
P769	Segment #12 TB30 Analog Output Value	0.00	0.00	{VDC}	10.00	TB30 configuration parameter must be set to accept this value: P150 = 10
	Segment #13					
P770	Segment #13 Frequency Setpoint	0.0	-500.0	{Hz}	500.0	If P112 = 1, negative sign forces reverse direction
P771	Segment #13 Accel/Decel Time	20.0	0.0	{sec}	3600.0	
P772	Segment #13 Time in current step	0.0 0	0.0 0	{P708} {P708}	6553.5 65535	Scaling/units depend on P708 Skip segment if time = 0
P773	Segment #13 Digital Output State	0	**Value set in P773** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** Relay (Bit 0) | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 TB14 (Bit 1) | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 I/O option Relay (Bit 2) | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 NOTE: P441 is the Relay Output (TB-19, 20, 21) of the optional Digital I/O module (ESVZAL0, ESVZAL1).			bit = 0: OFF (De-energized) bit = 1: ON (Energized) The corresponding digital output/relay must be set to accept data from the sequencer: P140, P142, P441 = 27
P774	Segment #13 TB30 Analog Output Value	0.00	0.00	{VDC}	10.00	TB30 configuration parameter must be set to accept this value: P150 = 10
	Segment #14					
P775	Segment #14 Frequency Setpoint	0.0	-500.0	{Hz}	500.0	If P112 = 1, negative sign forces reverse direction
P776	Segment #14 Accel/Decel Time	20.0	0.0	{sec}	3600.0	
P777	Segment #14 Time in current step	0.0 0	0.0 0	{P708} {P708}	6553.5 65535	Scaling/units depend on P708 Skip segment if time = 0
P778	Segment #14 Digital Output State	0	**Value set in P778** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** Relay (Bit 0) | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 TB14 (Bit 1) | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 I/O option Relay (Bit 2) | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 NOTE: P441 is the Relay Output (TB-19, 20, 21) of the optional Digital I/O module (ESVZAL0, ESVZAL1).			bit = 0: OFF (De-energized) bit = 1: ON (Energized) The corresponding digital output/relay must be set to accept data from the sequencer: P140, P142, P441 = 27
P779	Segment #14 TB30 Analog Output Value	0.00	0.00	{VDC}	10.00	TB30 configuration parameter must be set to accept this value: P150 = 10

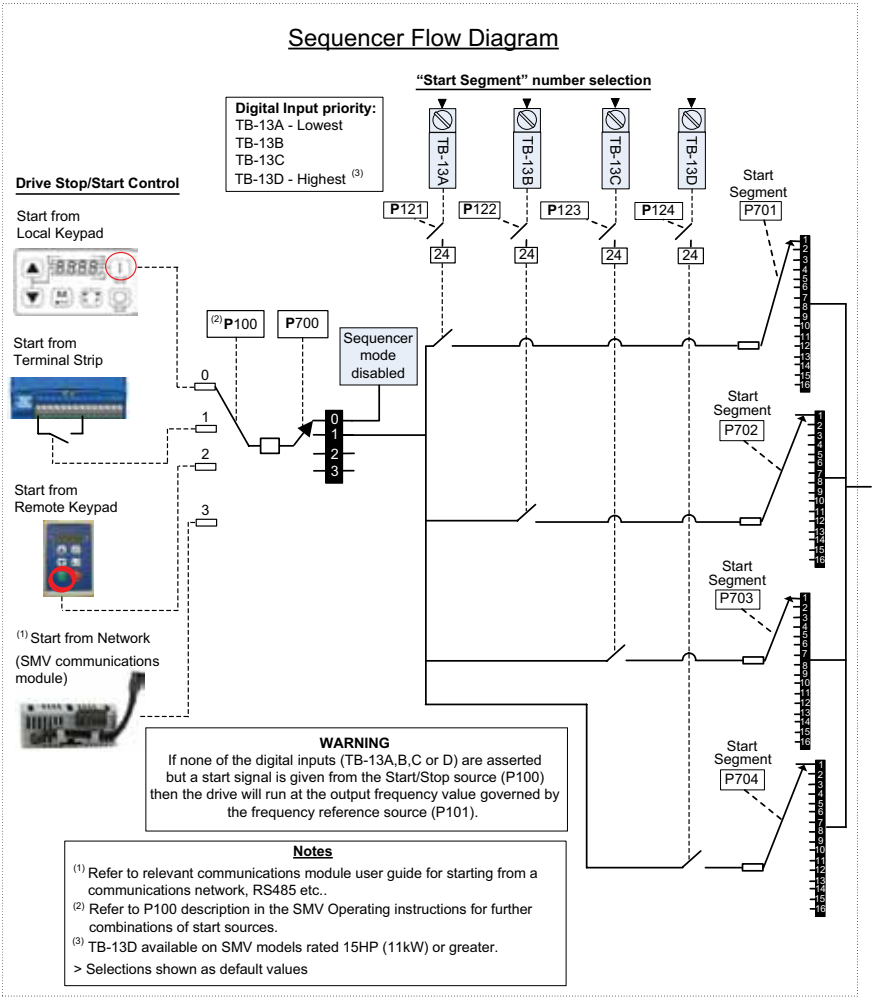
Code		Possible Settings				IMPORTANT
No.	Name	Default	Selection			
	Segment #15					
P780	Segment #15 Frequency Setpoint	0.0	-500.0	{Hz}	500.0	If P112 = 1, negative sign forces reverse direction
P781	Segment #15 Accel/Decel Time	20.0	0.0	{sec}	3600.0	
P782	Segment #15 Time in current step	0.0 0	0.0 0	{P708} {P708}	6553.5 65535	Scaling/units depend on P708 Skip segment if time = 0
P783	Segment #15 Digital Output State	0	**Value set in P783** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** Relay (Bit 0) | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 TB14 (Bit 1) | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 I/O option Relay (Bit 2) | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 NOTE: P441 is the Relay Output (TB-19, 20, 21) of the optional Digital I/O module (ESVZAL0, ESVZAL1).			bit = 0: OFF (De-energized) bit = 1: ON (Energized) The corresponding digital output/relay must be set to accept data from the sequencer: P140, P142, P441 = 27
P784	Segment #15 TB30 Analog Output Value	0.00	0.00	{VDC}	10.00	TB30 configuration parameter must be set to accept this value: P150 = 10
	Segment #16					
P785	Segment #16 Frequency Setpoint	0.0	-500.0	{Hz}	500.0	If P112 = 1, negative sign forces reverse direction
P786	Segment #16 Accel/Decel Time	20.0	0.0	{sec}	3600.0	
P787	Segment #16 Time in current step	0.0 0	0.0 0	{P708} {P708}	6553.5 65535	Scaling/units depend on P708 Skip segment if time = 0
P788	Segment #16 Digital Output State	0	**Value set in P788** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** Relay (Bit 0) | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 TB14 (Bit 1) | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 I/O option Relay (Bit 2) | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 NOTE: P441 is the Relay Output (TB-19, 20, 21) of the optional Digital I/O module (ESVZAL0, ESVZAL1).			bit = 0: OFF (De-energized) bit = 1: ON (Energized) The corresponding digital output/relay must be set to accept data from the sequencer: P140, P142, P441 = 27
P789	Segment #16 TB30 Analog Output Value	0.00	0.00	{VDC}	10.00	TB30 configuration parameter must be set to accept this value: P150 = 10
	End Segment					
P790	End Segment: Frequency Setpoint	0.0	-500.0	{Hz}	500.0	If P112 = 1, negative sign forces reverse direction
P791	End Segment: Accel/Decel Time	5.0	0.0	{sec}	3600.0	
P792	End Segment: Delay before P793, 794 & 795 activation		0.0 0	{P708} {P708}	6553.5 65535	Scaling/units depend on P708
P793	End Segment: Digital Output State		**Value set in P793** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** Relay (Bit 0) | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 TB14 (Bit 1) | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 I/O option Relay (Bit 2) | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 NOTE: P441 is the Relay Output (TB-19, 20, 21) of the optional Digital I/O module (ESVZAL0, ESVZAL1).			bit = 0: OFF (De-energized) bit = 1: ON (Energized) The corresponding digital output/relay must be set to accept data from the sequencer: P140, P142, P441 = 27

Code		Possible Settings		IMPORTANT
No.	Name	Default	Selection	
P794	End Segment: TB30 Analog Output Value	0.00	0.00 {VDC} 10.00	TB30 configuration parameter must be set to accept this value: P150 = 10
P795	End Segment: Drive Action	0	0 Keep Running 1 Stop (based on P111) 2 Coast to Stop 3 Quick Stop (per P127) 4 Coast with DC Brake 5 Ramp with DC Brake	Recovery: Toggling the START SEQUENCE will start the cycle from 'end segment Stop' or 'end segment DC Brake'.
		⚠	**WARNING!** If P795 = 0 then toggling the start sequence input will also restart the sequencer cycle but in the interim where TB13X is open the drive will ramp to the standard or specified alternate speed source depending on the drive configuration.	

⚠ **WARNING**

If the input defined to "Start Sequence" is opened during a sequence, the drive will exit sequencer mode and will run at the specified standard or alternate speed source (dependent on drive configuration).

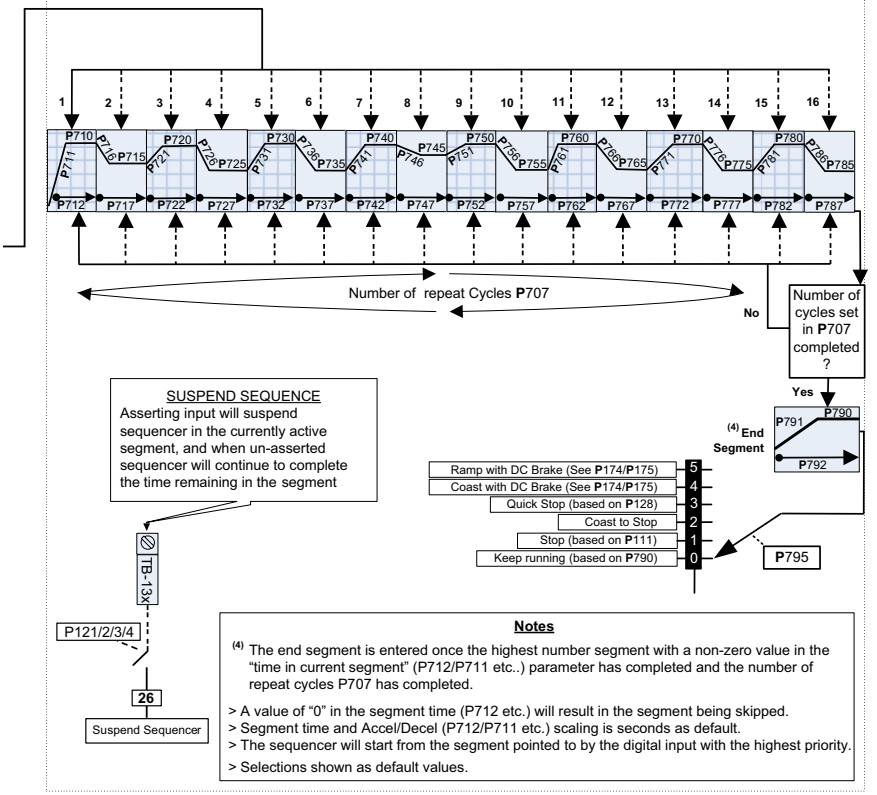
4.5.9.1 Sequencer Flow Diagram Left


Sequencer Flow Diagram
"Start Segment" number selection
Digital Input priority:
TB-13A - Lowest
TB-13B
TB-13C
TB-13D - Highest (3)
TB-13A
TB-13B
TB-13C
TB-13D
Drive Stop/Start Control
Start from Local Keypad
Start from Terminal Strip
Start from Remote Keypad
(1) Start from Network (SMV communications module)
P121
P122
P123
P124
24
Start Segment P701
Start Segment P702
Start Segment P703
Start Segment P704
(2) P100
P700
Sequencer mode disabled
0
1
2
3
WARNING
If none of the digital inputs (TB-13A,B,C or D) are asserted but a start signal is given from the Start/Stop source (P100) then the drive will run at the output frequency value governed by the frequency reference source (P101).
Notes
(1) Refer to relevant communications module user guide for starting from a communications network, RS485 etc..
(2) Refer to P100 description in the SMV Operating instructions for further combinations of start sources.
(3) TB-13D available on SMV models rated 15HP (11kW) or greater.
> Selections shown as default values

WARNING
If the input defined to "Start Sequence" is opened during a sequence, the drive will exit sequencer mode and will run at the specified standard or alternate speed source (dependent on drive configuration).

4.5.9.2 Sequencer Flow Diagram Right

Action after Stop/Start (P100) transition/digital input (if setup for sequencer mode) transition or restart after trip.	
P706	**Action**
0	Restart at beginning of sequence (pointed by TB13x)
1	Restart at beginning of current segment
2	Start at beginning of prior segment
3	Start at beginning of next segment

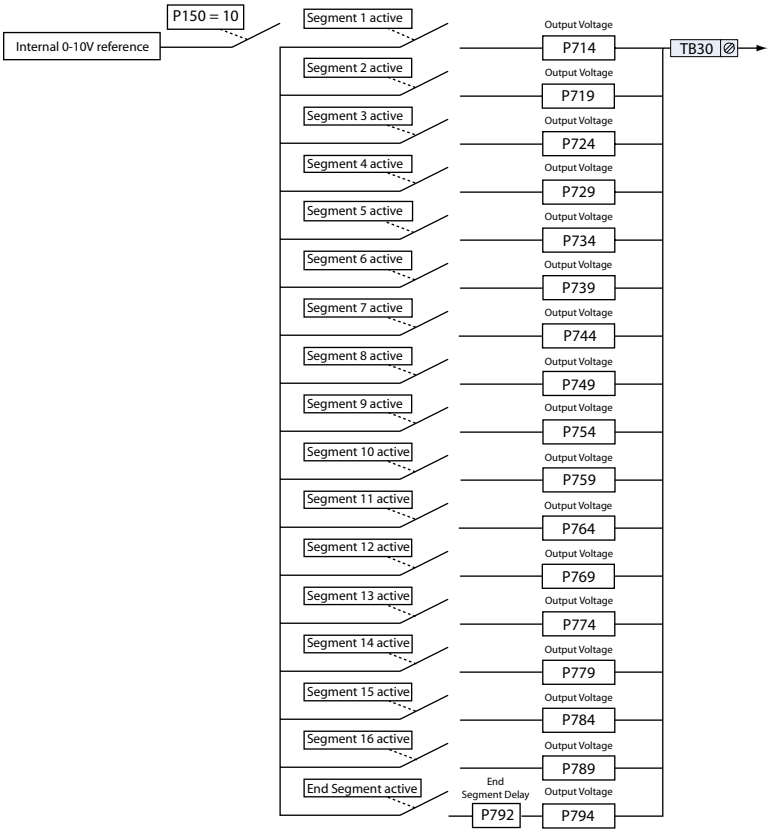


Notes

(4) The end segment is entered once the highest number segment with a non-zero value in the "time in current segment" (P712/P711 etc..) parameter has completed and the number of repeat cycles P707 has completed.

> A value of "0" in the segment time (P712 etc.) will result in the segment being skipped.
> Segment time and Accel/Decel (P712/P711 etc.) scaling is seconds as default.
> The sequencer will start from the segment pointed to by the digital input with the highest priority.
> Selections shown as default values.

4.5.9.3 Sequencer Status



NOTE
On the “End Segment”, the output voltage is not present until after the end segment delay P792 has expired. On the other segments the output voltage is present on entry to the segment. The same is true for the digital outputs.

(1) The drive can only be restarted if the error message has been reset.

5 Troubleshooting and Diagnostics

5.1 Status/Warning Messages

Status / Warning		Cause	Remedy
br	DC-injection brake active	DC-injection brake activated • activation of digital input (P121...P124 = 18) • automatically (P110 = 2, 4...6) • automatically (P111 = 1, 3)	Deactivate DC-injection brake • deactivate digital input • automatically after P175 time has expired
bF	Drive ID warning	The Drive ID (P502) stored on the EPM does not match the drive model.	• Verify motor data (P302…P306) and perform Auto Calibration. • Set drive mode (P300) to 0 or 1 • Reset the drive (P199 to 3 or 4) and reprogram.
CAL	Motor Auto-calibration active	Refer to P300, P399	Motor Auto-calibration is being performed
cE	An EPM that contains valid data from a previous software version has been installed	An attempt was made to change parameter settings	Parameter settings can only be changed after the EPM data is converted to the current version (P199 = 5)
CL	Current Limit (P171) reached	Motor overload	• Increase P171 • Verify drive/motor are proper size for application
dEC	Decel Override	The drive has stopped decelerating to avoid tripping into **HF** fault, due to excessive motor regen (2 sec max).	If drive trips into **HF** fault: • Increase P105, P126 • Install Dynamic Braking option
Err	Error	Invalid data was entered, or an invalid command was attempted	
FCL	Fast Current Limit	Overload	Verify drive/motor are proper size for application
FSt	Flying Restart Attempt after Fault	P110 = 5,6	
GE	OEM Settings Operation warning	An attempt was made to change parameter settings while the drive is operating in OEM Settings mode.	In OEM Settings mode (P199 = 1), making changes to parameters is not permitted.
GF	OEM Defaults data warning	An attempt was made to use (or reset to) the OEM default settings (P199 = 1 or 2) using an EPM without valid OEM data.	Install an EPM containing valid OEM Defaults data
LC	Fault Lockout	The drive attempted 5 restarts after a fault but all attempts were unsuccessful (P110 = 3...6)	• Drive requires manual reset • Check Fault History (P500) and correct fault condition
PdEC	PID Deceleration Status	PID setpoint has finished its ramp but the drive is still decelerating to a stop.	
PId	PID Mode Active	Drive has been put into PID Mode.	Refer to P200
SLP	Sleep Mode is active	Refer to P240...P242	
SP	Start Pending	The drive has tripped into a fault and will automatically restart (P110 = 3...6)	To disable Auto-Restart, set P110 = 0...2
SPd	PID Mode disabled.	Drive has been taken out of PID Mode. Refer to P200.	
StoP	Output frequency = 0 Hz (outputs U, V, W inhibited)	Stop has been commanded from the keypad, terminal strip, or network	Apply Start command (Start Control source depends on P100)

(1) The drive can only be restarted if the error message has been reset.

5.2 Drive Configuration Messages

When the Mode button is pressed and held, the drive's display will provide a 4-digit code that indicates how the drive is configured. If the drive is in a Stop state when this is done, the display will also indicate which control source commanded the drive to Stop (the two displays will alternate every second).

Configuration Display			
Format = x.y.zz	**x = Control Source:** L = Local Keypad t = Terminal Strip r = Remote Keypad n = Network	**y = Mode:** S = Speed mode P = PID mode t = Torque mode C = Sequencer mode	**zz = Reference:** CP = Keypad ▲ ▼ EU = 0-10 VDC (TB-5) E I = 4-20 mA (TB-25) JG = Jog nt = Network OP = MOP P 1 ... P7 = Preset 1...7 0 1 ... 16 = Sequencer Segment
	Example: L_S_CP = Local Keypad Start control, Speed mode, Keypad speed reference t_P_EU = Terminal Strip Start control, PID mode, 0-10 VDC setpoint reference t_C_ 12 = Terminal Strip Start control, Sequencer Operation (Speed mode), Segment #12 n_t_P2 = Network Start control, Vector Torque mode, Preset Torque #2 reference n_S_03 = Network Start control, Speed mode, Speed reference from Sequencer segment #03		
Stop Source Display			
Format = x_StP	L_StP = Stop command came from Local Keypad t_StP = Stop command came from Terminal Strip r_StP = Stop command came from Remote Keypad n_StP = Stop command came from Network		

5.3 Fault Messages

The messages below show how they will appear on the display when the drive trips. When looking at the Fault History (P500), the F_ will not appear in the fault message.

Fault		Cause	Remedy [1]
F_AF	High Temperature fault	Drive is too hot inside	• Reduce drive load • Improve cooling
F_AL	Assertion Level fault	• Assertion Level switch is changed during operation • P120 is changed during operation • P100 or P121...P124 are set to a value other than 0 and P120 does not match the Assertion Level Switch.	• Make sure the Assertion Level switch and P120 are both set for the type of input devices being used, prior to setting P100 or P121...P124. Refer to 3.2.3 and P120.
F_bF	Personality fault	Drive Hardware	• Cycle Power • Power down and install EPM with valid data • Reset the drive back to defaults (P199 = 3, 4) and then re-program • If problem persists, contact factory technical support
F_CF	Control fault	An EPM has been installed that is either blank or corrupted	
F_cF	Incompatible EPM fault	An EPM has been installed that contains data from an incompatible parameter version	
F_cFt	Forced Translation fault	An EPM from an old drive put in new drive causes drive to trip F_cFT fault.	Press [M] (mode button) twice to reset

Fault		Cause	Remedy [1]
F_dbF	Dynamic Braking fault	Dynamic braking resistors are overheating	• Increase active decel time (P105, P126, P127). • Check mains voltage and P107
F_EF	External fault	• P121…P124 = 21 and that digital input has been opened. • P121…P124 = 22 and that digital input has been closed.	• Correct the external fault condition • Make sure digital input is set properly for NC or NO circuit
F_F 1	EPM fault	EPM missing or defective	Power down and replace EPM
F_F2 … F_F 12	Internal faults		Contact factory technical support
F_Fnr	Control Configuration Fault	The drive is setup for REMOTE KEYPAD control (P100=2 or 5) but is not setup to communicate with a remote keypad	Set P400 = 1, or P600 = 1
		The drive is setup for NETWORK ONLY control (P100=3) but is not setup for network communications	Set P400 or P600 to a valid network communications protocol selection
F_FoL	TB25 (4-20 mA signal) Threshold fault	4-20 mA signal (at TB-25) drops below the value set in P164.	• Check signal/signal wire • Refer to parameters P163 and P164.
F_GF	OEM Defaults data fault	Drive is powered up with P199 =1 and OEM settings in the EPM are not valid.	Install an EPM containing valid OEM Defaults data or change P199 to 0.
F_HF	High DC Bus Voltage fault	Mains voltage is too high	Check mains voltage and P107
		Decel time is too short, or too much regen from motor	Increase active decel time (P105, P126, P127) or install Dynamic Braking option
F_ IL	Digital Input Configuration fault (P121... P124)	More than one digital input set for the same function	Each setting can only be used once (except settings 0 and 3)
		Only one digital input configured for MOP function (Up, Down)	One input must be set to MOP Up, another must be set to MOP Down
		PID mode is entered with setpoint reference and feedback source set to the same analog signal	Change PID setpoint reference (P121…P124) or feedback source (P201).
		One of the digital inputs (P121…P124) is set to 10 and another is set to 11…14.	Reconfigure digital inputs
		One of the digital inputs (P121…P124) is set to 11 or 12 and another is set to 13 or 14.	
		PID enabled in Vector Torque mode (P200 = 1 or 2 and P300 = 5)	PID cannot be used in Vector Torque mode
F_uF	Remote keypad fault	Remote keypad disconnected	Check remote keypad connections
F_LF	Low DC Bus Voltage fault	Mains voltage too low	Check mains voltage
F_n Id	No Motor ID fault	An attempt was made to start the drive in Vector or Enhanced V/Hz mode prior to performing the Motor Auto-calibration	Refer to parameters P300…P399 for Drive Mode setup and calibration.
F_nEF	Module communication fault	Communication failure between drive and Network Module.	Check module connections
F_nF 1 … F_nF9	Network Faults	Refer to the module documentation. for Causes and Remedies.	

Fault		Cause	Remedy [1]
F_0F	Output fault: Transistor fault	Output short circuit	Check motor/motor cable
		Acceleration time too short	Increase P104, P125
		Severe motor overload, due to: • Mechanical problem • Drive/motor too small for application	• Check machine / system • Verify drive/motor are proper size for application
		Boost values too high	Decrease P168, P169
		Excessive capacitive charging current of the motor cable	• Use shorter motor cables with lower charging current • Use low capacitance motor cables • Install reactor between motor and drive.
		Failed output transistor	Contact factory technical support
F_0F1	Output fault: Ground fault	Grounded motor phase	Check motor and motor cable
		Excessive capacitive charging current of the motor cable	Use shorter motor cables with lower charging current
F_PF	Motor Overload fault	Excessive motor load for too long	• Verify proper setting of P108 • Verify drive and motor are proper size for application
F_rF	Flying Restart fault	Controller was unable to synchronize with the motor during restart attempt; (P110 = 5 or 6)	Check motor / load
F_SF	Single-Phase fault	A mains phase has been lost	Check mains voltage
F_UF	Start fault	Start command was present when power was applied (P110 = 0 or 2).	• Must wait at least 2 seconds after power-up to apply Start command • Consider alternate starting method (P110).
F_FAU	TB5 (0-10V signal) Threshold fault	0-10V signal (at TB5) drops below the value set in P158.	• Check signal/signal wire • Refer to parameters P157 and P158

(1) The drive can only be restarted if the error message has been reset.

Appendix A

A.1 Permissable Cable Lengths

The table herein lists the permissable cable lengths for use with an SMV inverter with an internal EMC filter.

NOTE
This table is intended as a reference guideline only; application results may vary. The values in this table are based on testing with commonly available low-capacitance shielded cable and commonly available AC induction motors. Testing is conducted at worst case speeds and loads.

Maximum Permissible Cable Lengths (Meters) for SMV Model with Internal EMC Filters									
Mains	**Model**	**4 kHz Carrier (P166 = 0)**		**6 kHz Carrier (P166 = 1)**		**8 kHz Carrier (P166 = 2)**		**10 kHz Carrier (P166 = 3)**	
		Class A	Class B	Class A	Class B	Class A	Class B	Class A	Class B
240 V, 1-phase (2/PE)	ESV251ⅆⅆ2SFⅆ	38	12	35	10	33	5	30	N/A
	ESV371ⅆⅆ2SFⅆ	38	12	35	10	33	5	30	N/A
	ESV751ⅆⅆ2SFⅆ	38	12	35	10	33	5	30	N/A
	ESV112ⅆⅆ2SFⅆ	38	12	35	10	33	5	30	N/A
	ESV152ⅆⅆ2SFⅆ	38	12	35	10	33	5	30	N/A
	ESV222ⅆⅆ2SFⅆ	38	12	35	10	33	5	30	N/A
400/480 V,3-phase (3/PE)	ESV371ⅆⅆ4TFⅆ	30	4	25	2	20	N/A	10	N/A
	ESV751ⅆⅆ4TFⅆ	30	4	25	2	20	N/A	10	N/A
	ESV112ⅆⅆ4TFⅆ	30	4	25	2	20	N/A	10	N/A
	ESV152ⅆⅆ4TFⅆ	30	4	25	2	20	N/A	10	N/A
	ESV222ⅆⅆ4TFⅆ	30	4	25	2	20	N/A	10	N/A
	ESV302ⅆⅆ4TFⅆ	30	4	25	2	20	N/A	10	N/A
	ESV402ⅆⅆ4TFⅆ	54	5	48	3	42	2	N/A	N/A
	ESV552ⅆⅆ4TFⅆ	54	5	48	3	42	2	N/A	N/A
	ESV752ⅆⅆ4TFⅆ	54	5	48	3	42	2	N/A	N/A

NOTE: The "ⅆⅆ" and "ⅆ" symbols are place holders in the Model part number that contain different information depending on the specific configuration of the model. Refer to the SMV Type Number Designation table in section 2.2 for more information.

Notes

Notes

Lenze AC Tech Corporation
630 Douglas Street • Uxbridge, MA 01569 • USA
Sales: 800 217-9100 • Service: 508 278-9100
www.lenzeamericas.com

Document: SV01M-e1

The Control Box

Those Quattroflow-1000 S/1200 S pumps, that are equipped with a 370 W AC-Drive do have a Control Box to operate the pump.

Frontview of the Control Box (Lenze Keypad)

Mains Switch. Turn clockwise to switch on the unit.
The additional forced cooling fan starts.
Shown in the displayt: "STOP".

Press "Green Key" to start the pump.

"Arrow Up" to increase rpm
"Arrow Down" to decrease rpm

Display shows: "Hz"
(max. 60 Hz = max. rpm 1.800)

Press "Red Key" to stop the pump.

The AC motor is controlled by a VFD.

Manufacturer: Lenze/AC-Tech,TypeSMVector.
The keypad is used to operate the VFD.

The keypad can also be used to set the parameters of the VFD.

Please follow the instructions of the Lenze/AC-Tech Manual to set the parameters.

We recommend that the changing of the preset parameters should only be done by skilled personell.

Quattroflow-1200 S Pump
Motor: 370 W, 230/400 VAC
Speed Control: Lenze/SMVector

Please read the Lenze/AC-Tech Manual if you want to set or change parameters.

The table below shows the parameters that are preset by Quattroflow.

This table shows only those parameters that are different from Lenze/AC-Tech standard setting.

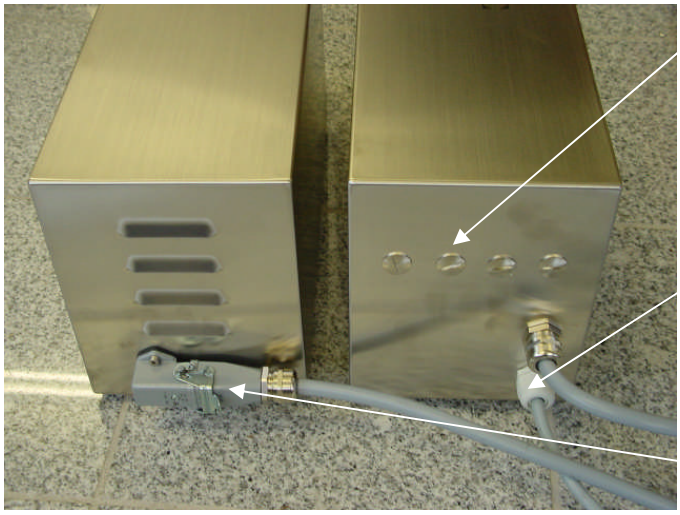
Parameter	Default	Quattroflow	Notes
P 100	0	2	
P104	20	1,0	
P105	20	1,0	
P109	0	1	
P166	1	3	
P169	0,0	15,0	
P170	0,0	10,0	
P194	225	111	
P300	0	4	
P302		230	
P303		1,9	
P304	60	50	
P305	1750	1370	
P400		1	

Caution! Warning!

Please read this Manual before you start up the pump for the first time. Please follow all safety and operation advices.

Connecting the cables to the 1200 S Pump

Please check all cables before you connect these to the pump or mains. Do not use the pump or connect the cables if the cables are damaged or hurt.
The cables are "pin-coded". Please connect the plug with the proper socket.
Please push the plug into the socket before you fix the plug with the clamp.



Caution! Warning!

Before you start the pump ..... always check your set-up!
Never start the pump if the downstream line is closed or too narrow!
The downstream line has to be open!
Starting or running the pump against a restricted downstream line might destroy the diaphragm of the pump or other equipment.

Do not exceed the max. pressure: 6 bars

When using tubes at the downstream line please make sure that the pressure rating of these tubes can hold your discharge pressure!

Diameter of the Suction line
Please make sure that the open diameter of the suction line can handle the demanded flow rate. Avoid cavitation!

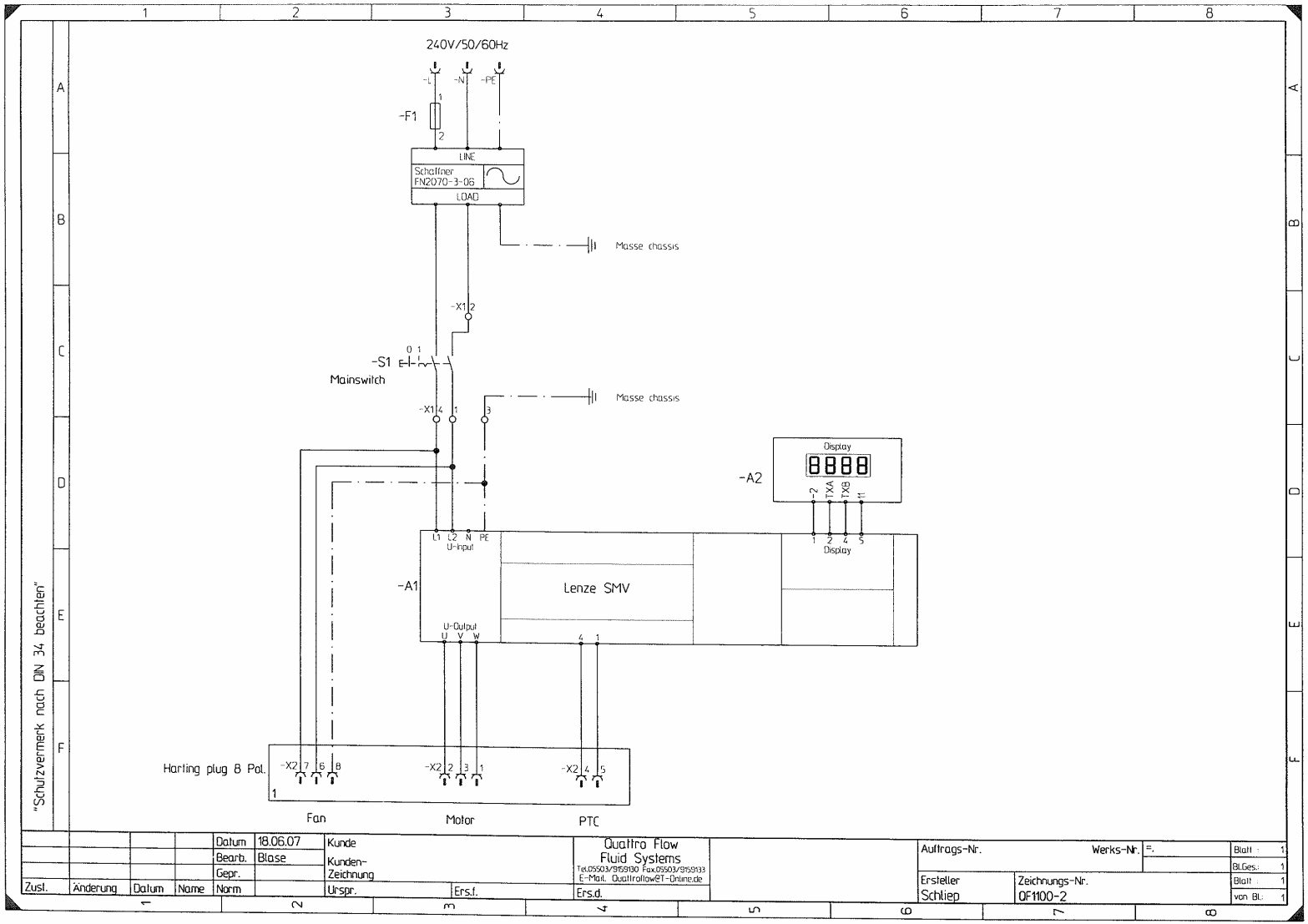
Quattroflow-1200 S Pump
Motor: 0,37 kW, 230/400 VAC
Speed Control: Lenze/SMVector

Please read the Lenze/AC-Tech Manual if you want to set or change parameters.

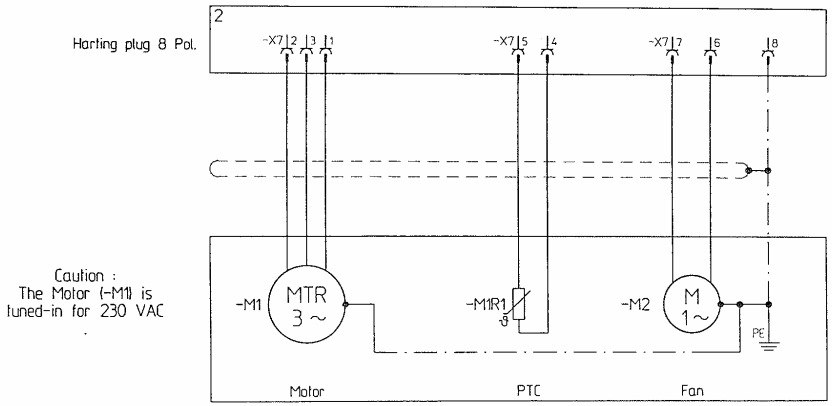
The table below shows the parameters that are preset by Quattroflow.

This table shows only those parameters that are different from Lenze/AC-Tech standard setting.

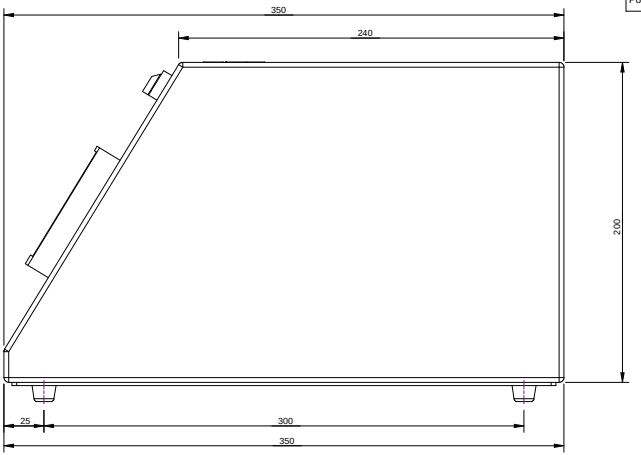
Parameter	Default	Quattroflow	Notes
P 100	0	2	Standard
P100	0	1	Only for P121 of 13
P101	0	1 or 2	1 if 0-10 V input, 2 if 4-20mA input
P103	60	70	
P104	20	1,0	
P105	20	1,0	
P109	0	1	
P121	0	21	for internal pressure switch off
P121	0	13	for start/stop extern
P136	0	0,5	only for relay output
P140	0	7	only for relay output
P166	1	3	
P169	0,0	15,0	
P170	0,0	10,0	
P194	225	111	
P300	0	4	
P302		230	
P303		1,64	
P304	60	50	
P305	1750	1330	
P306	0,8	0,75	
P400		1	

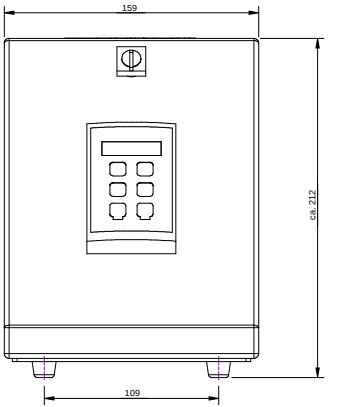

240V/50/60Hz
-L
-N
-PE
-F1
LINE
Schaffner
FN2070-3-06
LOAD
Masse chassis
-X1
-S1
Mainswitch
Masse chassis
-X1
-A2
Display
TXA
TXB
-A1
L1 L2 N PE
U-Input
Lenze SMV
U-Output
U V W
Display
Harting plug 8 Pol.
-X2
-X2
-X2
Fan
Motor
PTC
"Schutzvermerk nach DIN 34 beachten"
Datum 18.06.07
Bearb. Blase
Gepr.
Kunde
Kunden-
Zeichnung
Urspr.
Ers.f.
Ers.d.
Quattro Flow
Fluid Systems
Tel.05503/919190 Fax.05503/919133
E-Mail. QuattroFlow@T-Online.de
Zust.
Änderung
Datum
Name
Norm
Auftrags-Nr.
Werks-Nr.
Ersteller
Schliep
Zeichnungs-Nr.
QF1100-2
Blatt : 1
Bl.Ges.: 1
Blatt : 1
von Bl.: 1

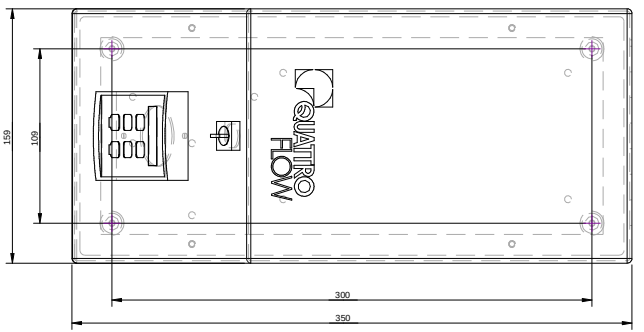
"Schutzvermerk nach DIN 34 beachten"

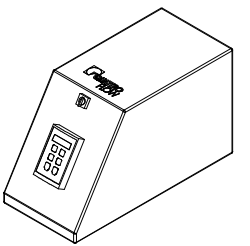


				Datum	08.04.05	Kunde	Quattro Flow Fluid Systems Tel.05503/9159130 Fax.05503/9159133 E-Mail. QuattroflowET-Online.de		Auftrags-Nr.	Werks-Nr.	Blatt : 1
				Bearb.	Blase	Kunden-Zeichnung					Bl.Ges.: 1
				Gepr.					Ersteller Schliep	Zeichnungs-Nr. 0F10-M0	Blatt : 1
Zust.	Änderung	Datum	Name	Norm		Urspr.	Ers.f.	Ers.d.			von Bl.: 1









Pos.	Änderungsindex	Datum	Visum	Prüfung

Pos.	Menge	Benennung	Sonderausführung Mit Schrauben M6		Sachnummer
Gezeichnet von Schaberg		Geprüft von	Geprüft am	Dateiname	Gezeichnet am 26.11.07	Maßstab 1 : 2

QUATTRO Fluid Systems FLOW

Steuergerät QF1200-S		
Einbaumaße	Version 01	Blatt-Nr. 1 / 1

ALMATEC Maschienenbau GmbH
Carl-Friedrich-Gauß-Str.5
47475 Kamp-Lindfort

Zertifikat / Certificate Class VI/FDA

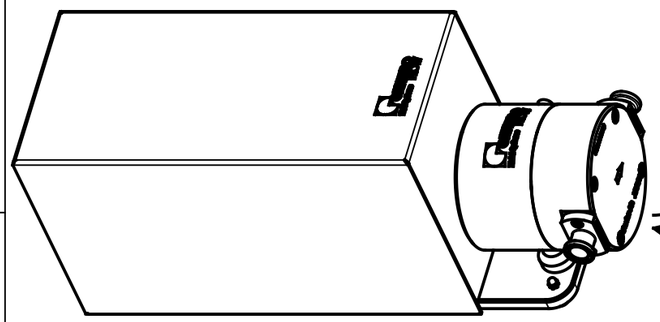
Hiermit bestätigen wir, dass in den Quattroflow Pumpen und Ersatzteilkits der Baureihen QF150/QF150 SU, QF1000, QF1200/QF1200 SU, QF4400/QF4400 SU,QF20K folgende Materialien eingesetzt werden.

We confirm that the following plastic- / elastomeric materials are used for the items of the Quattroflow pumps and spare part kits: Series QF150/150SU, QF1000, QF1200/ QF1200 SU , QF4400/QF4400 SU, QF 20K.

Bauteil **Item**	**In Pumpe / in Kit** **In Pump / in Kit**	**Material** **Material**	**USP Plastic** **Class VI / 121°C**	**FDA 21 CFR** **§177.2600/-.1520**
			Cert. issued by:	**Cert. issued by:**
Polypropylen				
Ventilplatte / Valve Plate	Quattroflow 1000	PP-DWST natur	BioService Proj. Nr. 072098	ISEGA 24903 U 07
Ventilplatte / Valve Plate	Quattroflow 4000/4400	PP-DWST natur	BioService Proj. Nr. 072098	ISEGA 24903 U 07
Ventilplatte / Valve Plate	Quattroflow 20K	PP-DWST natur	BioService Proj. Nr. 072098	ISEGA 24903 U 07
Förderkammer / Pump Chamber	Quattroflow 1200-SU	PP-DWST natur	BioService Proj. Nr. 072098	ISEGA 24903 U 07
Förderkammer / Pump Chamber	Quattroflow 4400-SU	PP-DWST natur	BioService Proj. Nr. 072098	ISEGA 24903 U 07
EPDM				
Ventile / Valves	Quattroflow 150/150SU	EPDM AA7IEZ	BioService Proj. Nr. 063083	Cert.- Kraiburg
Ventile / Valves	Quattroflow 1000	EPDM AA7IEZ	BioService Proj. Nr. 063083	Cert.- Kraiburg
Ventile / Valves	Quattroflow 1200	EPDM AA7IEZ	BioService Proj. Nr. 063083	Cert.- Kraiburg
Ventile / Valves	Quattroflow 1200-SU	EPDM AA7IEZ	BioService Proj. Nr. 063083	Cert.- Kraiburg
Ventile / Valves	Quattroflow 4000/4400	EPDM AA7IEZ	BioService Proj. Nr. 063083	Cert.- Kraiburg
Ventile / Valves	Quattroflow 4400-SU	EPDM AA7IEZ	BioService Proj. Nr. 063083	Cert.- Kraiburg
Ventile / Valves	Quattroflow 20K	EPDM AA7IEZ	BioService Proj. Nr. 063083	Cert.- Kraiburg
O-Ringe/O-rings	Quattroflow 150/150SU	70 EPDM 291	Cert.-Freudenberg	Cert.-Freudenberg
O-Ringe/O-rings	Quattroflow 1000	70 EPDM 291	Cert.-Freudenberg	Cert.-Freudenberg
O-Ringe/O-rings	Quattroflow 1200	70 EPDM 291	Cert.-Freudenberg	Cert.-Freudenberg
O-Ringe/O-rings	Quattroflow 1200-SU	70 EPDM 291	Cert.-Freudenberg	Cert.-Freudenberg
O-Ringe/O-rings	Quattroflow 4400-SU	70 EPDM 291	Cert.-Freudenberg	Cert.-Freudenberg
O-Ringe/O-rings	Quattroflow 4000/4400	70 EPDM 291	Cert.-Freudenberg	Cert.-Freudenberg
O-Ringe/O-rings	Quattroflow 20K	70 EPDM 291	Cert.-Freudenberg	Cert.-Freudenberg
O-Ringe/O-rings	PI2994	70 EPDM 291	Cert.-Freudenberg	Cert.-Freudenberg
Santoprene				
Membran/Diaph.	Quattroflow 150/150SU	281-73 Medical Grade	Cert.-Santoprene	Cert.-Santoprene
Membran/Diaph.	Quattroflow 1000	281-73 Medical Grade	Cert.-Santoprene	Cert.-Santoprene
Membran/Diaph.	Quattroflow 1200	281-73 Medical Grade	Cert.-Santoprene	Cert.-Santoprene
Membran/Diaph.	Quattroflow 1200-SU	281-73 Medical Grade	Cert.-Santoprene	Cert.-Santoprene
Membran/Diaph.	Quattroflow 4400-SU	281-73 Medical Grade	Cert.-Santoprene	Cert.-Santoprene
Membran/Diaph.	Quattroflow 4000/4400	281-73 Medical Grade	Cert.-Santoprene	Cert.-Santoprene
Membran/Diaph.	Quattroflow 20K	281-73 Medical Grade	Cert.-Santoprene	Cert.-Santoprene

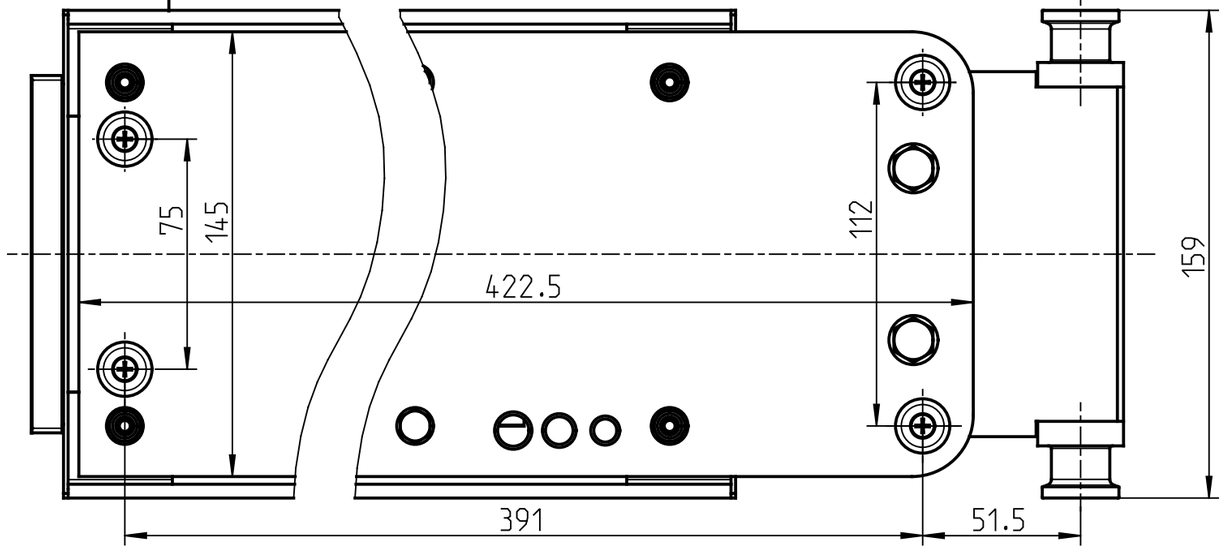
05.01.2012
Datum / Date

Unterschrift / Signature

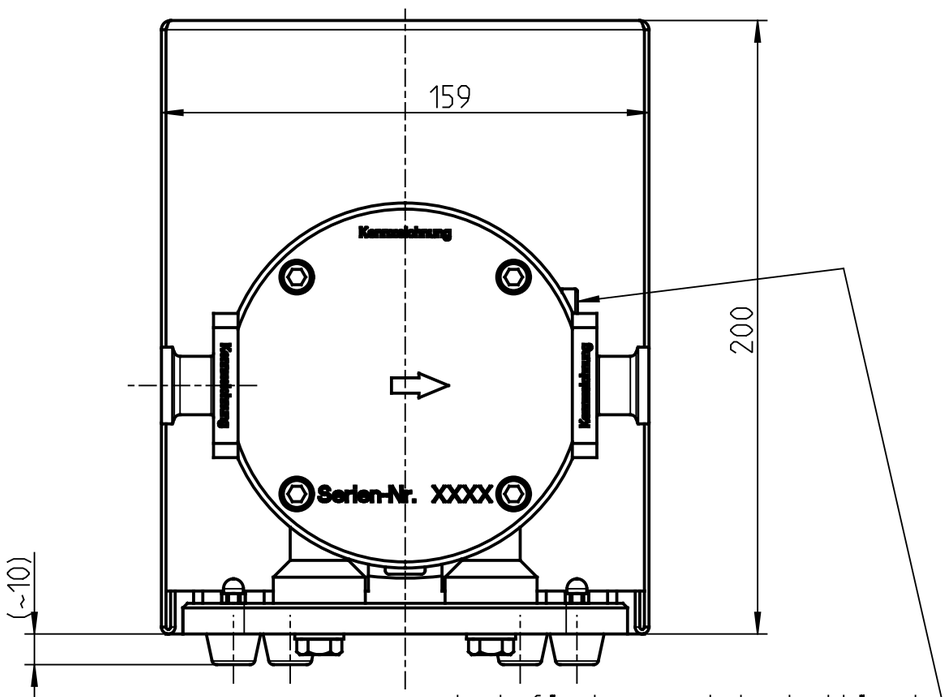


1:5

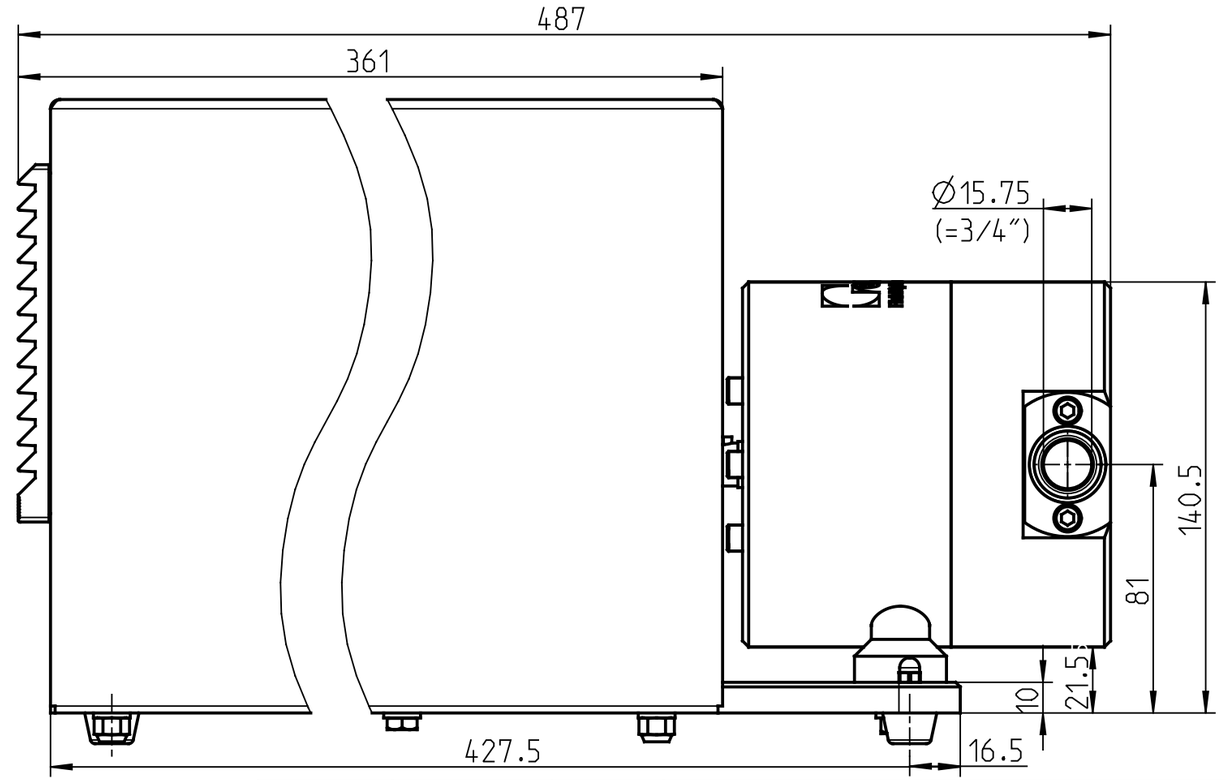
Wir empfehlen für einen schnellen Förderkammerwechsel diesen Bereich der Pumpe nicht zu verbauen.
We recommend this area of the pump not to obstruct for a quick changing of the pump chamber.



Die Förderkammer kann in 90° Schritten ohne Funktionseinschränkung gedreht werden.
It is possible to turn the pump chamber in 90° steps without functional interferences.



Loch für Innensechskantschlüssel zum Lösen des Klemmringes.
Hole for inside hexagonal key in order to solve the clamp ring of the pump chamber.



Index	Art der Änderung/ Grund	Datum	Name

Kanten DIN ISO 13715	Maßstab 1:2		Masse 25.238kg
		Datum	Name
Allgemeintoleranz DIN ISO 2768-m-S	Bear.	19.05.09	Linnemann
	Gepr.	-	-
	Norm		

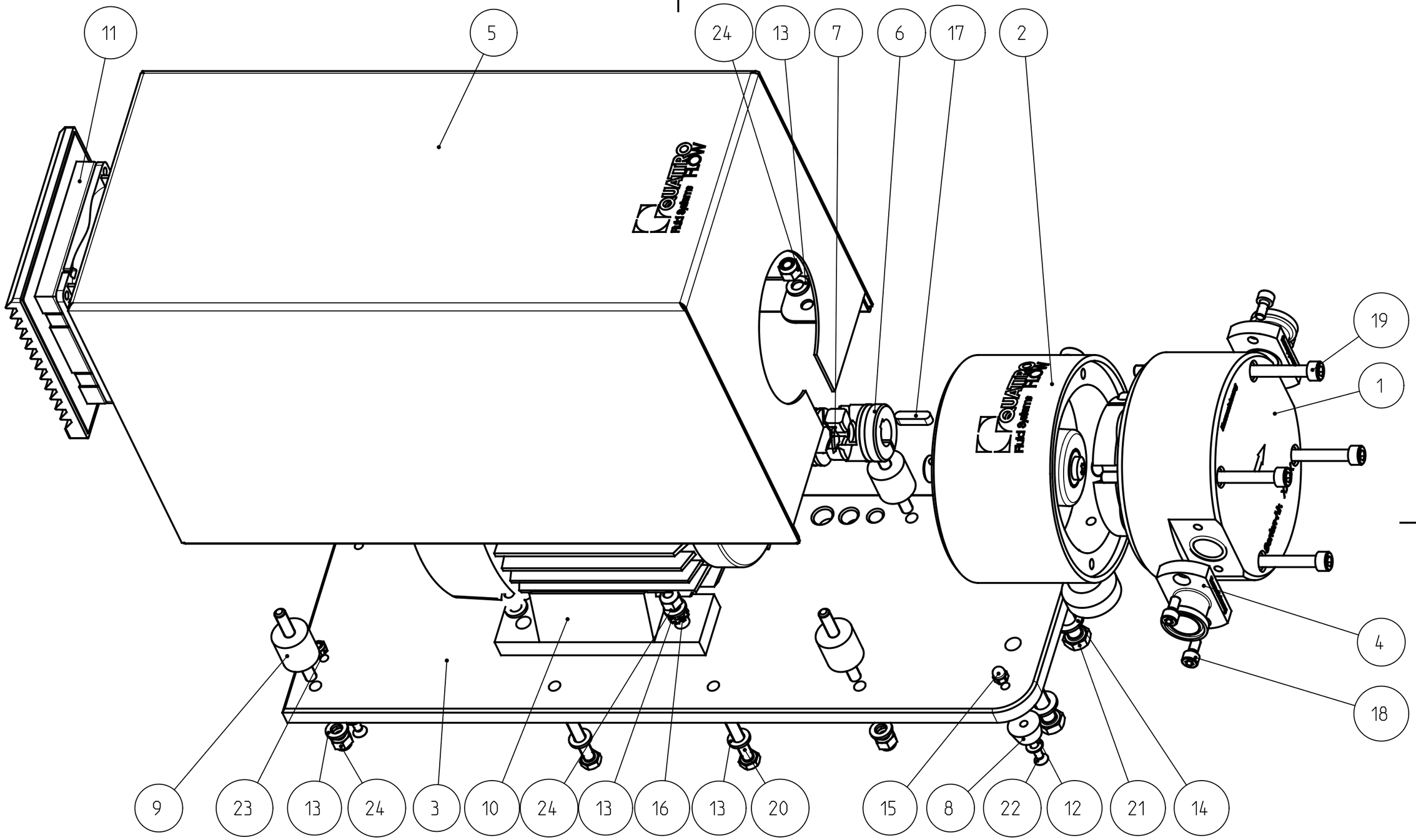
Material - / siehe Stueckliste
Halbzeug -
Benennung: -
Modell:PQ12ISH05_01H

Pumpe, komplett
Standard im Horizontalaufbau

Zeichnungsnummer+Änderungsindex: Datei:PQ12ISH05_01H
PQ12ISH05_01H -
Blatt 1
3 Bl.

(Ers. f.:) Q12-0000-01
(Ers. d.:)

QUATTRO FLOW Fluid Systems



Index	Art der Änderung/ Grund	Datum	Name

Kanten DIN ISO 13715	Maßstab 1:2		Masse 25.238kg
		Datum	Name
Allgemeintoleranz DIN ISO 2768-m-S	Bear.	19.05.09	Linnemann
	Gepr.	-	-
	Norm		

Material - / **siehe Stueckliste**
Halbzeug -
Benennung: -
Modell:PQ12ISH05_01H

Pumpe, komplett
Standard im Horizontalaufbau

Zeichnungsnummer+Änderungsindex: Datei:PQ12ISH05_01H
PQ12ISH05_01H -
Blatt 2 / 3 Bl.

(Ers. f.:) Q12-0000-01
(Ers. d.:)

Lfd. Nr.	Menge	Einheit	Benennung (Kategorie/Dateiname)	Sachnummer/Norm-Kurzbezeichnung	Bemerkung
1.	1	BG.	Foerderkammer pump chamber	PQ12C_01 -	- siehe Stueckliste
2.	1	BG.	Ringantrieb 5' ring drive	PQ12RA5_01 -	- siehe Stueckliste
3.	1	Stk.	Grundplatte mit Kabeldurchfuehrung Baseplate	Q12-014-05 b	1.4301 X6CrNiMoTi 17-12-2
4.	2	Stk.	Anschluss Connector	Q12-015-01 a	1.4435 X2CrNiMo 18-14-3
5.	1	Stk.	Haube fuer Pumpenmotor shroud for motor	Q12-031-01 b	1.4301 bearbeitet
6.	2	Stk.	Kupplung Rotex GS14 AL-H (I-ø 14mm) coupling	550147151449 -	Lieferanten-spezifisch Aluminium
7.	1	Stk.	Zahnkranz Rotex-GS 98 Shore A-GS Rot coupling spider	550241000001 -	KTR-spezifisch Elastomer
8.	4	Stk.	Gummi-Puffer, weiss shock absorber, white	#25007 -	Lieferanten-spezifisch Elastomer
9.	4	Stk.	Gummi-Metall-Puffer shock absorber	Form 1(A) M6 (ø20xh20) -	Lieferanten-spezifisch Elastomer
10.	1	Stk.	Motor, 0,37kW motor	K21R-71-G4 -	- -
11.	1	Stk.	Schaltschrank-Luefter, 230V Fan- and Filter Unit, 230V	SK 3321 107 -	- -
12.	4	Stk.	Scheibe ähnlich ISO7089 washer	DIN125-4.3-A2 -	A2-70 Rostfreier Stahl
13.	16	Stk.	Scheibe ähnlich ISO7089 washer	DIN125-6.4-A2 -	A2-70 Rostfreier Stahl
14.	2	Stk.	Scheibe ähnlich ISO7089 washer	DIN125-8.4-A2 -	A2-70 Rostfreier Stahl
15.	2	Stk.	Hutmutter Acorn Nut	DIN1587-M4-A2 -	A2-70 Rostfreier Stahl
16.	1	Stk.	Zahnscheibe gemäß DIN6797 Form A washer	DIN6797-A 6.4-A2 -	A2-70 Rostfreier Stahl
17.	1	Stk.	Feder Key	DIN6885-A-5x5x20 -	1.0503 C45k
18.	4	Stk.	Zylinderschraube mit Innensechskant hexagonal socket head cap screw	DIN912-M5x10-A2 -	A2-70 Rostfreier Stahl
19.	4	Stk.	Zylinderschraube mit Innensechskant hexagonal socket head cap screw	DIN912-M6x60-A2 -	A2-70 Rostfreier Stahl
20.	4	Stk.	Sechskantschraube hexagonal bolt	DIN933-M6x35-A2 -	A2-70 Rostfreier Stahl
21.	2	Stk.	Sechskantschraube hexagonal bolt	DIN933-M8x45-A2 -	A2-70 Rostfreier Stahl
22.	4	Stk.	Senkkopfschraube mit Kreuzschlitz phillip head socket bolt	DIN965-M4x20-A2 -	A2-70 A2-70
23.	2	Stk.	Mutter, selbsichernd lock nut	DIN985-M4-A2 -	A2-70 Rostfreier Stahl
24.	12	Stk.	Mutter, selbsichernd lock nut	DIN985-M6-A2 -	A2-70 Rostfreier Stahl

Kanten DIN ISO 13715	Maßstab 1:2	Masse 25.238kg	Material - / siehe Stueckliste	
			Halbzeug -	
	Datum	Name	Benennung: -	Modell:PQ12ISH05_01H
Allgemeintoleranz DIN ISO 2768-m-S	Bear. 19.05.09	Linnemann	Pumpe, komplett Standard im Horizontalaufbau	
	Gepr. -	-		
	Norm			
			Zeichnungsnummer+Änderungsindex: Datei:PQ12ISH05_01H	Blatt 3
QUATTRO FLOW Fluid Systems			PQ12ISH05_01H -	3 Bl.
			(Ers. f.:) Q12-0000-01	(Ers. d.:)

CERTIFICATE

Management system as per
DIN EN ISO 9001 : 2008

In accordance with TÜV NORD CERT procedures, it is hereby certified that

Almatec Maschinenbau GmbH
Carl-Friedrich-Gauß-Straße 5
47475 Kamp-Lintfort
Germany

applies a management system in line with the above standard for the following scope

Development, production and selling of diaphragm pumps and pulsation dampers; sale of centrifugal pumps, gear pumps, eccentric disc pumps, vane pumps, peristaltic hose pumps and lobe pumps

Certificate Registration No. 04 100 940508
Audit Report No. 3505 2404

Valid until 2013-02-10
Initial certification 1994

Certification Body
at TÜV NORD CERT GmbH

Essen, 2010-02-16

This certification was conducted in accordance with the TÜV NORD CERT auditing and certification procedures and is subject to regular surveillance audits.

TÜV NORD CERT GmbH Langemarckstrasse 20 45141 Essen www.tuev-nord-cert.com

TGA-ZM-07-06-00

ALMATEC Maschienenbau GmbH
Carl-Friedrich-Gauß-Str.5
47475 Kamp-Lindfort

Zertifikat / Certificate Class VI/FDA

Hiermit bestätigen wir, dass in den Quattroflow Pumpen und Ersatzteilkits der Baureihen QF150/QF150 SU, QF1000, QF1200/QF1200 SU, QF4400/QF4400 SU,QF20K folgende Materialien eingesetzt werden.

We confirm that the following plastic- / elastomeric materials are used for the items of the Quattroflow pumps and spare part kits: Series QF150/150SU, QF1000, QF1200/ QF1200 SU , QF4400/QF4400 SU, QF 20K.

Bauteil **Item**	**In Pumpe / in Kit** **In Pump / in Kit**	**Material** **Material**	**USP Plastic** **Class VI / 121°C**	**FDA 21 CFR** **§177.2600/-.1520**
			Cert. issued by:	**Cert. issued by:**
Polypropylen				
Ventilplatte / Valve Plate	Quattroflow 1000	PP-DWST natur	BioService Proj. Nr. 072098	ISEGA 24903 U 07
Ventilplatte / Valve Plate	Quattroflow 4000/4400	PP-DWST natur	BioService Proj. Nr. 072098	ISEGA 24903 U 07
Ventilplatte / Valve Plate	Quattroflow 20K	PP-DWST natur	BioService Proj. Nr. 072098	ISEGA 24903 U 07
Förderkammer / Pump Chamber	Quattroflow 1200-SU	PP-DWST natur	BioService Proj. Nr. 072098	ISEGA 24903 U 07
Förderkammer / Pump Chamber	Quattroflow 4400-SU	PP-DWST natur	BioService Proj. Nr. 072098	ISEGA 24903 U 07
EPDM				
Ventile / Valves	Quattroflow 150/150SU	EPDM AA7IEZ	BioService Proj. Nr. 063083	Cert.- Kraiburg
Ventile / Valves	Quattroflow 1000	EPDM AA7IEZ	BioService Proj. Nr. 063083	Cert.- Kraiburg
Ventile / Valves	Quattroflow 1200	EPDM AA7IEZ	BioService Proj. Nr. 063083	Cert.- Kraiburg
Ventile / Valves	Quattroflow 1200-SU	EPDM AA7IEZ	BioService Proj. Nr. 063083	Cert.- Kraiburg
Ventile / Valves	Quattroflow 4000/4400	EPDM AA7IEZ	BioService Proj. Nr. 063083	Cert.- Kraiburg
Ventile / Valves	Quattroflow 4400-SU	EPDM AA7IEZ	BioService Proj. Nr. 063083	Cert.- Kraiburg
Ventile / Valves	Quattroflow 20K	EPDM AA7IEZ	BioService Proj. Nr. 063083	Cert.- Kraiburg
O-Ringe/O-rings	Quattroflow 150/150SU	70 EPDM 291	Cert.-Freudenberg	Cert.-Freudenberg
O-Ringe/O-rings	Quattroflow 1000	70 EPDM 291	Cert.-Freudenberg	Cert.-Freudenberg
O-Ringe/O-rings	Quattroflow 1200	70 EPDM 291	Cert.-Freudenberg	Cert.-Freudenberg
O-Ringe/O-rings	Quattroflow 1200-SU	70 EPDM 291	Cert.-Freudenberg	Cert.-Freudenberg
O-Ringe/O-rings	Quattroflow 4400-SU	70 EPDM 291	Cert.-Freudenberg	Cert.-Freudenberg
O-Ringe/O-rings	Quattroflow 4000/4400	70 EPDM 291	Cert.-Freudenberg	Cert.-Freudenberg
O-Ringe/O-rings	Quattroflow 20K	70 EPDM 291	Cert.-Freudenberg	Cert.-Freudenberg
O-Ringe/O-rings	PI2994	70 EPDM 291	Cert.-Freudenberg	Cert.-Freudenberg
Santoprene				
Membran/Diaph.	Quattroflow 150/150SU	281-73 Medical Grade	Cert.-Santoprene	Cert.-Santoprene
Membran/Diaph.	Quattroflow 1000	281-73 Medical Grade	Cert.-Santoprene	Cert.-Santoprene
Membran/Diaph.	Quattroflow 1200	281-73 Medical Grade	Cert.-Santoprene	Cert.-Santoprene
Membran/Diaph.	Quattroflow 1200-SU	281-73 Medical Grade	Cert.-Santoprene	Cert.-Santoprene
Membran/Diaph.	Quattroflow 4400-SU	281-73 Medical Grade	Cert.-Santoprene	Cert.-Santoprene
Membran/Diaph.	Quattroflow 4000/4400	281-73 Medical Grade	Cert.-Santoprene	Cert.-Santoprene
Membran/Diaph.	Quattroflow 20K	281-73 Medical Grade	Cert.-Santoprene	Cert.-Santoprene

05.01.2012
Datum / Date

Unterschrift / Signature